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CONTENTS OF No. 170.

	PAGE
Pleasant Hours with the Microscope. By H. J. Slack	77
The Earth's Shape and Motions. (*Illus.*) By R. A. Proctor	78
An Electric Tram-Car. By. W. Slingo	80
Needed Star-Surveys. By R. A. Proctor	81
Rambles with a Hammer. By W. Jerome Harrison	83
Chats on Geometrical Measurement. By R. A. Proctor	84
Chapters on Modern Domestic Economy	85
How to Take Care of a Tricycle. By John Browning	86
Wooden Magnets to Cure Disease	87
Newton *v.* Descartes	87
The Beginning of Life. (*Illus.*) By R. A. Proctor	88
Editorial Gossip	90
Reviews: Legends of the Algonquin Indians. By Edward Clodd	91
Some Books on Our Table	92
Face of the Sky. By F.R.A.S.	93
Correspondence	94
Our Inventors' Column	97
Our Chess Column	98

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

THE plan adopted in these papers has been to have the objects described always under view at the time of writing, even when they were familiar to the writer. A temporary interruption has lately caused delay, but the present opportunity may be taken to reply to the wish for some hints on mounting objects. The practised mounter will only want an occasional mention of new methods, but the beginner may be assisted by some elementary instructions. Of all the modes of mounting objects that require to have their transparency increased and their tissues preserved from change, that effected with the help of Canada balsam is the most important, and the student should learn how to apply it under different circumstances before he tries other plans. Canada balsam is a sort of turpentine, and usually sold by chemists and opticians in a perfectly clear and clean state, about the thickness of stiffish glue. This is too thick for a great many purposes, and it is a good way to put about half the quantity in the usual squat bottles in which it is supplied, or say, a dessert-spoonful into another wide-mouthed squat bottle, and pour over it a teaspoonful of pure benzine, or benzole as it is sometimes called. This should be stirred in with a little stick or glass rod, and kept for a few hours in a warm place. If the bottle is not placed too near a fire, it may be corked, to prevent evaporation, but it must not then be allowed to get hot enough to risk its bursting. If the balsam is not found to be about as thin as gum-water is usually prepared, a little more benzine should be added. This requires care, as when a certain degree of thinning is reached, further additions of the solvent act with unexpected rapidity in making the solution more fluid. If it is too thin, leaving the cork out and placing it near the fire will soon make it thicker again. The whole supply of balsam should never be thinned, as it is wanted in different states for different objects. A good one to begin with is a wing of any fly, like the house-fly, or of an insect not bigger than a wasp or bee. A few hairs of a mouse, or rat, or hairy caterpillar will do very well, or a few dried spiral vessels pulled out of a rhubarb stalk. The reason for selecting some such object to begin with is that more delicate ones, or thicker ones, require more skill and care to avoid spoiling them. Whatever may be selected of the sort advised, place it in the centre of a glass slide, and drop a very little of the thinned balsam upon it. The operator should keep a little stick, like a pencil, cut to a point, for this purpose. It will take up a minute droplet for small objects, or a large drop for bigger ones, and should be wiped clean with a rag moistened with benzine when done with. As soon as a drop of balsam is on the object, a thin glass cover should be superposed. If this is done gently, and steadily, and accurately, so as not to require a further lateral movement to adjust it, the balsam will spread evenly, without air-bubbles. If the cover-glass is large—say from $\frac{5}{8}$ in. to $\frac{7}{8}$ in. in diameter—it is sometimes well to let one edge rest on the slide, and then allow it to fall gently on the object. The operator should have at hand a few of the little spring clips sold by opticians, and use one to press the cover firmly down. Balsam thinned with benzole, or with another excellent solvent, wood-naphtha—also called pyroligneous ether and pyroxillic spirit—hardens readily by evaporation of the solvent in a warm place, and if there is no occasion for rapidity, it may be left for some hours in a fender, or for a day or two in a warm room. A quicker method is to place the slide on a little table of sheet-brass, supported by four legs, and high enough to put a spirit-lamp under. It is best to apply only a gentle heat, and the lamp need not be directly under the slide, as the whole brass-plate soon gets hot.

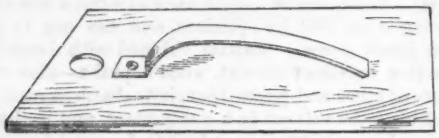
Balsam thinned with benzine will permit a quicker but rather more risky treatment when the objects are small and thin. As soon as the covering-glass is on and lightly pressed down it may be held over a spirit-lamp and just allowed to boil. It will then be full of small air-bubbles, which should be instantly squeezed out by pressure with a little stick. With practice this usually succeeds, and the balsam is at once made quite hard; but it is not advisable to try it with a rare object, or one that cannot be easily replaced. One danger is that the object may be driven out of the centre, or too near the edge of the cover. Another is that some air-bubbles may remain in an awkward place. The writer has, however, hundreds of slides successfully prepared in this way.

Large objects should always be mounted by slower methods, and professional mounters let them have, in some cases, a long while to harden. Thick objects, such as legs of bees, &c., want the balsam thicker. If they do not readily absorb the balsam, a previous soaking in spirits of turpentine is useful, and the balsam may be thinned with that solvent instead of benzine. If the object is too thick for the covering-glass to be pressed close to the slide, a shallow cell may be made by cutting a round or square hole in a piece of tinfoil, or punching a ring of that material. The tinfoil can be obtained of different thicknesses; some about as stout as an ordinary address-card is the handiest. Thin sheet-zinc will also do, or a piece of card. Brass rings flattened do for some cells; but Canada balsam gradually acts upon them, and a green copper salt makes its appearance. Glass cells are the best where a depth of 1-20th or more of an inch is required.

Many objects are injured by squeezing them too flat. The mouth organs of bees, flies, &c., for example, can scarcely be understood when superposed parts of their structure are all flattened into the same plane. Mounting in a shallow tinfoil cell is much better, and approaches the merit of fluid-mounting without its disadvantages. Sometimes it is necessary to get water out of an object without shrinking it by drying. The strongest alcohol will soon remove most of the water, and then a little soaking in a

drop of oil of cloves fits it to receive the balsam. Another way is to immerse the object for some minutes in a drop of saturated solution of carbolic acid; drain that off, and then apply the balsam, which agrees very well with the acid.

When the slides are quite hardened, the superfluous balsam may be removed easily with a rag wetted with either benzine or wood-naphtha. If there is much to take away, scraping with a penknife may be first resorted to. Chemists sometimes sell, under the name of benzine, an impure article which does pretty well to remove grease spots—though not *very* well—and is useless for thinning balsam. The best is highly volatile. Some objects require softening, which can be done by treating them with a solution of caustic potash, which must be washed out before mounting, and the water got rid of, as just explained. Besides the little spring-clips for pressing the covers down, stationers now keep a stout,



spring, paper-clip, with a wooden base, as in the annexed sketch. This is useful when more pressure is wanted than the light, brass, wire ones can give.

THE EARTH'S SHAPE AND MOTIONS.

By RICHARD A. PROCTOR.

CHAPTER VI.—THE EARTH'S REVOLUTION.

(*Continued from p. 25.*)

BRADLEY'S discovery of the aberration of the fixed stars forms one of the most interesting narratives in the whole range of the history of astronomy. Yet, here I must perforce leave it untouched, and deal only with the phenomenon itself, since properly to relate the steps by which he was guided to that most important discovery, would occupy all the rest of the space now available to me.

The great and general law, then, to which the apparent annual motions of the stars are subjected—a law which must be accounted for by any theory which pretends to exhibit the real relations of the celestial bodies—is this:—Every star in the heavens, whether obvious to the naked eye or visible only by the aid of powerful telescopes, whether shining in solitary splendour or lost, so to speak, in the profundities of some rich star-cluster, travels once a year in a minute ellipse, whose major axis is somewhat more than two-thirds of an arc-minute in length, while its minor axis depends on the position of the star with reference to that great circle on the heavens in which the sun seems annually to travel. A star close by the pole of this circle—the ecliptic—has an almost circular aberration-ellipse; one near the ecliptic itself has an aberration-ellipse so eccentric as to be almost a straight line. But every star has an aberration-ellipse of the same major axis. And that major axis, though, as I have said, minute, belongs to the order of magnitudes which are obvious to the telescopist—palpable, unmistakable, clear as the sun at noon to the worker in a well-appointed observatory.*

* The mere fact that Bradley, when telescopic appliances were so imperfect, at once recognised the aberrations of the first fixed star he watched with care, though he had no reason to look for or expect such a motion, is enough to show how very palpable the phenomenon is. But it may be well to add that astronomers can now recognise and feel certain about stellar displacements which are only about *one-hundredth* of the aberration motion.

Now let us inquire what the particular law is according to which these remarkable ellipses are described by the stars, for much depends on this point. If merely a vague notion is given of the character of this instructive phenomenon, then some vague and general explanations will immediately suggest themselves to the supporters of paradox. When the exact nature of aberration is described, the proof of the earth revolution will be found absolutely irrefragable.

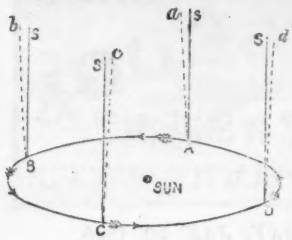


Fig. 1.

The best way of describing the nature of aberration is by a reference to the accepted theory of the earth's motion. Let A B C D, Fig. 1 represent the earth's path (perspectively presented) around the sun, and suppose a star so placed on the heavens as to occupy the pole of the ecliptic; then the star being at a distance practically infinite, we should expect the lines of sight from all the points in A B C D, to the star, to be directed towards this point—the ecliptic pole. In other words, the lines A S, B S, C S, D S, would all be at right angles to the plane A B C D. Instead of this, when the earth is at A, the star is seen towards *a*, the plane *a* A S passing through the tangent line to A B C D, at A. So when the earth is at B, the star is seen towards *b*, the plane *b* B S passing through the tangent to the circle A B C D at B. And similarly when the earth is at C or D, the star is apparently displaced as shown, towards *c* or *d* respectively, the displacement being always an angle of one-third of a minute (approximately), and always in the direction of the earth's motion.

Next suppose the star placed on the ecliptic. Then the earth's path being again represented by A, B, C, D, and the lines A S, B S, C S, D S (Fig. 2) being drawn in that plane parallel to each other to indicate the direction in which one would expect to see the star, it is found that, whereas when the earth is at A and C, where she is moving in a line towards or from the star, there is no displacement; when she is at B and D, where she is moving at right angles to the line of sight to the star, there is the same displacement as in the former case. Also, in this second case, the star seems more and more displaced as the earth travels from A to B, then less and less till the earth is at C, when there is no displacement; then more and more, but on the contrary side, till the earth is at D, and so finally less and less till the earth is again at A.

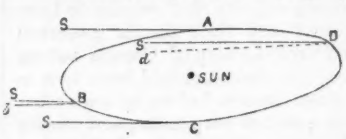


Fig. 2.

It will be easily seen that in the first case the star appears to describe a circle, A B C D, Fig. 3, about its mean position S, while in the latter it describes a straight line A B C D, Fig. 4, through its mean position S, D B, in Fig. 4, being equal to the diameter of the circle A B C D, in Fig. 3.

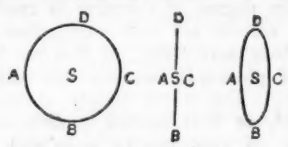


Fig. 3. Fig. 4. Fig. 5.

When the star is somewhere between either pole of the ecliptic and the ecliptic itself, it describes an ellipse, as A B C D, Fig. 5, always reaching its greatest excursion as at B and D, when the earth is travelling in a direction at right angles to the line of sight to the star (which necessarily happens twice a year), and its least excursion at A and C, when the earth is travelling as nearly as it can towards or from the star (which also necessarily happens twice a year).

Now it is to be noticed here that though I have made use of the accepted theory to describe the observed motions, this by no means involves the assumption that the accepted theory is correct. It *is* the fact, and it is a striking fact, that we cannot even *describe* stellar aberration conveniently without a reference to the accepted theory, so that even though that theory were false, it would still be convenient to speak of the aberrations of the stars, as being such as would correspond to such and such assumptions respecting terrestrial motion.

But here we have a phenomenon to explain. We have every star on the heavens announcing some great fact to us, or rather *writing for us year by year on the celestial concave a lesson for our instruction.* To reject the lesson as meaningless, would be to abandon one of the highest and noblest faculties given to man, his desire to search out and investigate the problems set by nature for his interpretation. What, then, is the meaning of this million-on-million-fold repeated lesson? Can astronomers explain the matter? Perhaps astronomers have some far-fetched explanation, which they would force on the world by crafty argument.

The case is otherwise. Astronomy can not only interpret the aberration motions of all the millions of stars revealed by the telescope, but the accepted theory of astronomy would have to be abandoned if those motions did not take place. Stellar aberration was discovered as by an accident, was long looked on as a great source of doubt and perplexity, was honestly submitted by astronomers to the inquiry of the world—and then suddenly it was seen that the aberration motions could not but take place if the earth moves as the accepted theory asserts. Let us inquire how this is.

It has been independently discovered, by observations made on the eclipses of Jupiter's satellites, that light travels with finite, though inconceivable, velocity. Always when Jupiter and his family were farthest from the earth, the satellites seemed tardiest to announce by appearance or by disappearance, their motion through the shadow of their primary. And so it was seen that the light messages sweeping to us from these bodies come at a definite speed to the earth. A consequence of this peculiarity had been wholly overlooked by astronomers. The light travelling in appreciably parallel lines from a star towards the solar system, may be compared to a shower falling in parallel lines on moving bodies. Now we know that in moving through a vertical shower of rain, the rain seems to fall somewhat towards the face. The reason is obvious; thus, suppose a traveller's face at 1, Fig. 6, when a rain drop is at R^1, and that by the time he reaches 2, the rain drop is at R^2, it is clear that the drop will seem to have fallen from a position in front of him, and in the direction indicated by the dotted lines. If we consider the motion of a small body travelling in a circle under a vertical shower, we shall see at once that this property may be made to illustrate every case of stellar aberration, by assuming different positions, as 1, 2, 3, in Fig. 7, for the circle in which the body moves under the shower.

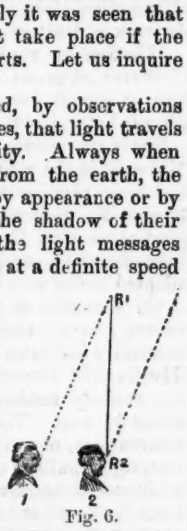


Fig. 6.

It will be seen, though, that, in order that this explanation may hold, it is necessary that the rate of motion of the earth should bear an appreciable relation to the enormous velocity of light. If rain fell a thousand times as fast as it actually does, the fastest runner would not find that a vertical rain-shower would seem to fall appreciably towards his face. Now, apart from all considerations of the real size of the earth's orbit, or of the rates of motion either of light or of the earth in her orbit, we can at once test this explanation of aberration. It had been *independently* shown by Römer that light takes about eight minutes in crossing the radius of the earth's orbit; the earth occupies a year in travelling round the circumference of the circle; all we want to know is, whether the displacement of a star over an arc of about one-third of a minute, corresponds to these relations. What we require is, that supposing S B (Fig. 8) to be the distance traversed by light in any time, B A the distance traversed by the earth in the same time, S B A being a right angle, the angle A S B should be about one third of a minute of arc. Let it be remembered that this was the problem as presented in Bradley's time by mere observation, and before any had noticed what a noble proof of the true theory of astronomy was to be adduced from it.

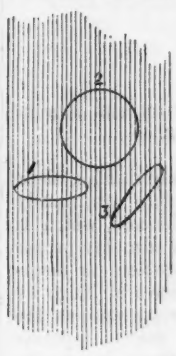


Fig. 7.

Fig. 8.

Now for the test of figures.

Since the earth completes a circuit of her orbit in one year, she would traverse a length equal to the radius in the period

$$\frac{365 \times 24 \times 60}{2\pi} \text{ minutes (roughly),}$$

where π represents the number 3·14159 . . . or the ratio of a circle's circumference to its diameter; and light traverses this distance in 8 minutes. Hence the velocity of light is to that of the earth as $\frac{365 \times 24 \times 60}{2\pi} : 8$; or as $32850 : \pi$. Now the proportion of B S to A B where A S B is an angle of about one-third of a minute of arc is $1 : \frac{\pi}{360 \times 60 \times 3}$ or $32400 : \pi$. It is seen then at once, that we have a satisfactory explanation even with these rough assumptions, since the difference between 32400 and 32850 is but one seventy-second part of 32400. But if I had taken the mean of the estimates of the velocity of light from observations made on Jupiter's eclipses, as determined before Bradley's observation, and Bradley's estimate of the aberration of the star γ Draconis as made before he knew what theory required, the coincidence would have been found very much closer.

Here, then, we have a perfect proof of the earth's revolution. No question can remain that the lesson really taught us by the stars as they annually traverse their aberration ellipses is this, that the earth annually traverses a nearly circular path round the sun. This interpretation accounts for all the peculiarities of the stellar aberration motions; nay, the theory of the earth's motion requires every one of those peculiarities. No other theory has ever

been put forward in explanation of stellar aberration,* and it may be alleged, with more than confidence, with the fullest certainty of conviction, that no other theory *can* explain the phenomenon.

CHAPTER VII.

The Earth's Motion as an Attendant on the Sun in his Journey through Space.

Since the stars are observed to be slowly shifting their positions on the celestial vault, and therefore presumably in space, it is obviously suggested that the sun, which is but a member of the sidereal family, has also his proper motion through space. It is a difficult problem to determine what that motion is, because all we have to judge by is the movement observable among the stars, and, as the stars are themselves in motion, it is not easy to separate the effects of their own motions from those due to the sun's.

Still, this problem has been attacked and fairly vanquished by astronomy. It is true we cannot here get certainty, because we no longer have absolutely certain relations to deal with. But, as it is certain that, supposing the sun to be moving in a definite direction, there would result a balance of stellar motions in the contrary direction; we can obviously deduce the direction of the sun's motion, by noticing the direction towards which the stars show the most noteworthy balance of motion. This has been done, and in many ways. The result is that astronomers point confidently to the constellation Hercules and its neighbourhood, as including the point towards which the sun is speeding. His rate of motion has been estimated at about 150,000,000 miles per annum, or between four and five miles per second.

I am only concerned here with the sun's proper motion, in so far as it relates to the earth's motions. The conception that the sun may be speeding through space with this enormous velocity seems, at first sight, so contrary to the fundamental hypothesis of modern astronomy, that many persons have been led to believe there is a real contradiction. They see that the earth's real path in space can no longer be looked upon as a closed curve, yet Kepler speaks of it as an ellipse; that, again, the earth—according to this new idea—is not travelling in a conic section, yet Newton says, all bodies under the influence of a central attracting force, such as gravity, must move in some conic section or other.

In reality, however, there is no difficulty. Modern astronomy only requires the earth and planets to move in ellipses *with respect to the sun*, not in space. Supposing the sun at rest, and the planets moving in their present ellipses around him, and that then under the action of far distant suns, our sun began to travel through space, the planets would not (as the paradoxer fears), be left behind. They would be under the influence of those attractions as well as the sun. They would obey them then, precisely as he does, obeying all his influences as before. Thus their motions, *with respect to him*, would not be changed even by a hair's breadth.

The end.

* I need take no further notice of a so-called explanation in a work purporting to be written by a Cambridge wrangler (name not given), than to remark that it does not even pretend to explain details, and that what it does pretend to do suffices to exhibit the utter ignorance of the writer as to the real nature of the problem. I do not say that the writer is not a Cambridge wrangler, because I know from my own experience that a man may become a wrangler without knowing even the definitions of astronomy. But I do say that the writer, being a wrangler, should have had sense enough to know that before pretending to write on astronomy, he ought to have acquired a better knowledge of the subject than he shows himself to possess.

AN ELECTRIC TRAMCAR.

By W. Slingo.

THE many experiments which have been made in England, as well as in France and Belgium, to test the applicability of electricity as a motive-power in place of horses, have proved so little successful that one may be pardoned for doubting the ultimate success of the movement for many a long year to come. The long continued and patiently pursued study of the question by the officers of the Electrical Power Storage Company has, however, resulted in what has every appearance of proving a success.

It must be borne in mind that if there is a form of locomotion in which electricity has anything like a prospect of being able to compete successfully with the present order of things, that form is to be found in the propulsion of tramcars. Here horses are almost the sole agent employed, and, as everyone can see without any great stretch of imagination, such an agent proves a highly expensive one. In some districts steam has been, or is being, tried as a substitute for horse-power, but while the expense is certainly less, the accidents which have so far resulted from the use of steam-propelled cars have fostered and increased a prejudice against them which is not likely to be speedily overcome. Doubtless, with more experience on the part of the drivers and other officers of the steam service, and greater familiarity with it on the part of the public, these accidents will be reduced to an insignificant minimum.

An electrically-propelled car, if it is to become a commercial success, must not only be capable of being worked at a lower cost than is involved in the adoption of either of the other alternatives, but it must be capable of doing its work at least as efficiently and harmlessly.

Whether or no these desiderata will be attained is, of course, at present a matter of uncertainty, but in the face of recent experiments there is every probability of success being accomplished.

The experiments in question have been carried out at Millwall, at the works of the company above referred to, and have been conducted by a very zealous and able electrician, Mr. Reckenzaun. An ordinary car which has seen good service on the London and Greenwich tram-line has been procured, and, with but few modifications, has been adapted to the new work.

On the floor of the car, under the seats, are series of rollers, and on these are run trays carrying a number of secondary batteries of the latest and most adaptable pattern. The front of the seat is boarded up, so that the batteries are entirely hidden from view, and their total weight is about $1\frac{1}{4}$ tons. The wires from these batteries are led to a commutator, or switch, at each end of the car, so that by turning or pulling over a handle the driver can apply or withdraw the motive-power at will. The current from the batteries is passed round the coils of one of Mr. Reckenzaun's motors, which is placed under the car, and is not seen unless looked for. The motor, which at full speed runs at about 1,000 revolutions per minute, is geared on to the axle of the driving-wheels, which are thus made to run at about eighty revolutions per minute. The motor is well covered in, whence there is little probability of its being easily clogged with dust or mud. The weight of the motor and gearing is about half a ton, so that the weight of the source

of motion is 1¾ tons, while the car which it propels weighs 2½ tons, or, when carrying the full number of passengers (46), 5½ tons. When we "compare this weight with that of a steam or compressed air locomotive (either of which will weigh from eight to ten tons to do the same amount of useful work), stored electrical energy has the advantage in proportion of about 5 to 1 so long as the propelling force is directly proportional to the weight moved." By manipulating the handle above referred to, the strength of the current may be varied, and the speed, which ranges between three and ten miles an hour, increased or decreased in a considerably shorter distance than is possible with horse-power; while, should necessity offer, a propelling power equal to that of sixteen horses may be applied at any moment.

The experimental line at Milwall is a difficult one. It is made somewhat roughly, and has a total length of 400 ft., forming near its centre a right angle with an extremely sharp curve, the radius being only 35 ft. One side of the angle is tolerably level, but with the curve commences an incline of 1 in 40, which gradually increases until it attains a maximum of 1 in 17 at the end of the journey. This steep incline has to be mounted without a run, a rush being prevented by the sharpness of the curve.

It is found that the driving batteries maintain a sufficient current for two hours, when they are changed for others fully charged, the changing being effected in a very simple way. A trolley with four series of rollers is brought opposite the end of the car, the two trays of exhausted cells are run out on to two series of rollers on the trolley, a winch is turned, the other two series of rollers carrying the fresh cells are brought opposite the openings in the car, and the trays then run in, the whole work of changing being accomplished in almost as little time as would be taken in changing horses.

The car is placed on small "bogie" frames, whereby the weight is so distributed as to permit of the ordinary light roads being retained in their present condition, while they also increase considerably the comfort of the passengers, more especially when turning sharp curves.

Electric bells are fitted so that each passenger, without leaving his seat, may signal to the driver to "stop;" while from the roof hang a number of electric lamps, the filaments of which are, when required, rendered incandescent by electricity derived from the cells under the seat.

There remains now but one question—that of cost. It has been the impression of most people that there were so many and such extensive sources of waste in the conversion of steam power into electric power, as applied by secondary cells, that their adoption would therefore be precluded. But Mr. Reckenzaun maintains that he gets on the axle of his car 33 per cent. of the power of his steam-engine. Locomotive steam-engines are always costly, and those used on tramways are no exception to the rule, as they consume three to four times as much fuel per horse-power as would be required by a large stationary-engine, such as would be used for charging the secondary cells; whence it is clear that the balance is considerably in favour of electricity. It is to be noticed, further, that while the prime cost of an electrical equipment is very much less than for steam-driven cars, the cost of maintenance is much lower, there being also fewer sources of depreciation, the chief of which are in the cells. The negative plates maintain their efficiency, but the positive plates gradually become peroxidized, and require renewing. Lead, however, is cheap, and the renewal is very easily effected.

It is stated that the running cost, including 15 per cent. depreciation on machinery, and 50 per cent. on the secondary cells (percentages which will probably present a good margin on the right side) amounts to 3½d. per car mile, as compared with about 7d. for horse-power.

The new system has already obtained the approval of Gen. Hutchinson, from the Board of Trade, and there is every prospect of its speedily being brought into public use: so soon, that is, as the local authorities can be induced to give the sanction necessary. It only remains to say that on the occasion of a visit which I made recently to Millwall, I was thoroughly convinced of the practicability of the system so far as the power to do the work was concerned, and it is safe to presume that the calculations which have been made as to cost have been taken on good grounds, and are well within the margin; at least, I hope so.

NEEDED STAR-SURVEYS.

BY RICHARD A. PROCTOR.

(*Continued from p. 42.*)

SUPPOSE we could pay a visit to the midst of the Pleiades. What should we find? According to ordinary ideas we should find simply a number of suns, each, like our own, the centre of a system of worlds. Yet it is demonstrable—and easily—that we should see around us something entirely unlike the star-strewn heavens that we now see. Probably most of the stars now visible to us would still be in sight, and scattered with much the same relation between the lustre and average apparent distance as in our present skies. But how about those stars which belong to the group we are visiting? With what lustre would the six stars shine which ordinary eyesight recognises in the Pleiades, or the fourteen stars which some keen eyes can discern in the group? It is certain, from the apparent size of the group, that the entire space of the Pleiades cannot be more than the fiftieth part of the distance separating the Pleiades from us. Therefore set in the middle of that group we should be within less than one hundredth of our present distance from all the stars of the group. Alcyone now shines as a third magnitude star, five others of the group as stars of the fourth magnitude. How would they appear if we diminished our distance to one hundredth part of its present amount? Their lustre would be increased, not a hundredfold, but one hundred times a hundredfold, or ten thousand times *at least*. Many of them would be far more greatly increased in brightness. They would no longer be stars, but suns, just as Sirius in the great reflector of Lord Rosse, though still but a mere point in apparent size, shines like a young sun. The scene presented by the hundred stars of the Pleiades would be indescribably beautiful. In the background would lie a star scene as beautiful as the heavens we now see; but it would be scarce noticeable amid the splendour of a hundred suns, the least outshining Sirius a hundredfold in splendour. And among these, the greater glories of the night skies within the Pleiades there would be varieties in glory as great as among the stars of our own skies; for the stars which *seem* so unequal in the Pleiades are *really* as unequal as they seem, since the whole group must be regarded as practically at the same distance from our earth.

But this is nothing compared with what we should find if we could visit some of those glorious clusters which have been poetically described by Tennyson as "bee-like swarms of suns." The idea that the stars of those clusters are distributed like the suns of our firmament, that we have merely to count their number and say *there* are so many suns each girt round by its family of worlds, and each repeating not only the glory of our own sun but all the

wonders of the solar system, is demonstrably incorrect. From the observed size of those clusters we know that the entire span is less than the thousandth part of the distance separating us from them. Yet at the distance at which they lie we can discern *separately* thousands of stars. Thus the average distance from star to star within some of these groups cannot be one millionth part of the distances separating those groups from us. The splendour of some among those stars, as seen from the midst of those groups, cannot therefore but exceed a billion* times their lustre as seen by us. Since then these stars can in the case of the more magnificent clusters be seen with very small telescopes, it follows that from the middle of those clusters they must shine with a glory comparable with that of our own sun, whose lustre at the distance of the nearest of our stars would not be reduced to more than one 50,000 millionth part. If then there are worlds circling round those suns, there can then be no night for their inhabitants, but probably a constant daylight exceeding many times in glory the most resplendent of our summer days. I should be disposed for my own part to imagine rather, though I must confess I *know* nothing on the subject, that if there be inhabited worlds at all in connection with a glorious cluster of this sort, they must be worlds circling round the whole cluster, not round the individual stars composing it. But more probably, I should say, there are no such worlds, but those clusters will hereafter aggregate into suns which in due course will become the centres of solar systems, more or less (probably very little) like the family of planets to which our earth belongs.

These considerations may serve to show what interest surrounds the inquiry into the architecture of the sidereal heavens. If two varieties of stellar arrangement alone suggest such diversity of condition, what might we not expect to follow from the consideration of all the peculiarities of stellar distribution which may be recognised when the heavens are carefully surveyed? It is to such work as is thus suggested that I referred in the opening remarks of my former article. The failure of the two methods of gauging, devised by Sir W. Herschel, should by no means discourage astronomers from prosecuting diligent researches into the noble problems dealt with by him. Not only, as I have shown, did each failure involve an important and quite unexpected discovery; but both these failures helped to show along what lines the inquiry may best be prosecuted.

I propose now briefly to consider what these lines are, touching somewhat on the work I have myself done in pursuance of this special inquiry, and dealing somewhat more fully with the work which has to be done (even in the earliest stages of the inquiry) wherein also I hope to bear a part.

Wilhelm Struve was led by his study of the papers of Sir W. Herschel to recognise—but only indistinctly—the importance of *combining* the principles which underlie the two methods of star-gauging:—

In any true survey of the star-depths it is manifestly essential that the system of counting stars with the same telescope, and as nearly as possible under the same conditions, should be carefully applied. And we shall not be led astray by this system if we do not interpret our results on an incorrect principle, as Sir Willlam Herschel did in the beginning of his work. Moreover, we can apply this system in ways which at first he would have rejected as useless. He supposed that the great gauging telescope which he applied reached in all directions to the very limits of the sidereal universe, and it is clear that nothing short of such a power as he thus supposed himself to be applying could have served his purpose if our galaxy were such a system as he imagined. But that particular space-penetrating power, though it did not do what Herschel had expected (because the stellar universe is not what he supposed it), and though it was unequal to the task of resolving all parts of the stellar heavens, disclosed, as we have seen, important truths. It is manifest that less telescopic power would have also given important results,—seeing that the condition Herschel had supposed essential to the validity of his survey had no real existence. Nor can one see any reason to limit the diminution of telescopic power by which useful results might be obtained. Without telescopic aid at all, the distribution of stars numerically might be well worth studying. Nay, it might be worth while to examine the distribution of stars visible with less than ordinary powers of vision.

It was the recognition of this (possibly a half-unconscious recognition) which seems to have suggested Herschel's second method of star gauging. In this he took only a very small region for survey, and examined that with constantly increasing telescopic power, under the idea that he was thus penetrating more and more deeply into space. Now this kind of research, too, is manifestly essential in any true survey of the star depths. Nor shall we be led astray by this system unless we misunderstand what we are doing. We *may* be penetrating more deeply into space as we increase our telescopic power, or we *may* simply be analysing more and more scrutinisingly a particular region of stellar space: more probably we are doing both. But if we keep our minds free from any bias one way or the other, our results will always be available for the increase of our knowledge so soon as we can co-ordinate them properly together, and combine them duly with results otherwise obtained. But manifestly we must for this purpose extend this method of survey to larger regions than Sir William Herschel dealt with. If his principle of interpretation had been sound, his plan of applying the method would have been all that was needed. But so soon as we recognise the unsoundness of the principle, and note how that unsoundness was shown by the study of small regions of the heavens, and how important in itself was the discovery thus made, we see that results of great importance may be obtained by extending the survey by this method. Nor can we see any reason to limit the extent of the survey thus made. It may be applied to the whole heavens, if only a large enough array of labourers can be persuaded to take part in the work.

The study of the proper way of applying each method points, then, to one and the same result,—viz., that the whole star sphere requires to be surveyed with every order of visual power (separately) from the unaided vision, or even from visual powers lower than ours ordinarily are, to the highest telescopic power that can be obtained.

A colossal work truly: but then, fortunately, it is not necessary that the whole work should be undertaken at once. Any part of it,—the survey of any portion of the heavens with such and such telescopic powers, or the survey with any definite telescopic power of the whole heavens or any part of them,—means so much added to our knowledge of the architecture of the complex system of stars of many orders, star-clusterings, star-clouds, and other forms of matter, which we call the Galaxy.

The elder Struve, recognising the importance of combining both systems of survey, began the task by a piece of work which cannot but be regarded as very rough indeed, though it has been enthusiastically admired by the

* By a billion I mean a million millions, by a trillion a million million millions, and so forth, the English way of reckoning, by which a billion, a trillion, a quadrillion and so forth, means a million raised to the second power, the third power, the fourth power, and so forth.

late Prof. Nichol, of Glasgow (Eng.), and some others who seem to have no idea of the real sort of work which is required in dealing with the architecture of the heavens.

Struve saw that some importance attaches to the inquiry whether stars of the brighter orders—such for instance as can be seen with a 2-inch telescope—are more richly strewn on the Milky Way than elsewhere. Clearly, according to Sir W. Herschel's earlier ideas they ought *not* to be. The range of distance around our sun within which such stars are included, on the assumption of generally equal distribution, falls well within the breadth of Herschel's flat-disc galaxy, and (on that assumption) it is only when we pass far beyond such distances, that we come either on the vacant space bordering the flat sides of our galaxy, or on the mighty vistas of stars along its regions of greatest extension which produce the soft light of the Milky Way. Here then was a general test for the validity of the method which Herschel had found to fail him only in specific instances.

(*To be continued.*)

RAMBLES WITH A HAMMER.

OVER CHARNWOOD FOREST.

By W. Jerome Harrison, F.G.S.

(*Continued from page 23.*)

THE great difficulty which besets us as to the true geological age of the Charnwood slates is the absence, in their neighbourhood, of any other old rocks whose relations to them we might ascertain. In Wales, for example, we feel positive that certain strata are of Cambrian age, although they contain no fossils, because we see Pre-Cambrian rocks *below* them and Silurian strata *above* them. But the oldest rocks which abut on Charnwood are the Carboniferous series. At Gracedieu, in the extreme north-west of the Forest (about midway between Whitwick and Sheepshed) the Mountain Limestone (Lower Carboniferous) rests on the Pre-Cambrian slates. It is here dolomitic, containing carbonate of magnesia in addition to carbonate of lime, but the ordinary fossils of this rock—large shells of the genus *Productus*—are fairly common. There is little, if any, true Millstone Grit above the Limestone, but the superincumbent Coal-measures stretch away to the west and south, forming the Leicestershire coalfield.

Above the ancient slaty rocks we have described—resting on their upturned edges—and of comparatively recent origin as compared with them, we find thin beds of reddish sandstone and marl, belonging to the Triassic formation. During the deposit of this red sandstone, Charnwood was evidently a little archipelago, the hill-tops standing as islands in the Triassic sea. In most of the granite and slate quarries these "red rocks" are seen resting on, and filling up hollows in the old eroded surface of the slaty and syenitic rocks.

Lastly (covering every other rock more or less irregularly), there is the Drift—the surface deposit of clay and sand full of stones—the result of the action of ice during the last glacial period. Glaciers advancing from the north rubbed over our Charnwood hills, and detached great blocks of rock, which they carried southwards, so that boulders of Mountsorrel granite and of Groby syenite are not uncommon round Rugby, and in Hertfordshire; while Mr. Lucy has traced similar fragments right across the country, from the Cotswold Hills (where he first found them and determined to track them home) to Charnwood. Dwellers in London should search for Charnwood rocks in the boulder-clay in the brick-pits of Finchley, on the northern brow of the Thames valley, beyond which the ice did not extend southwards.

The igneous or crystalline rocks of Charnwood are of considerable commercial importance, the "setts," or square blocks, made from them being largely used in the south and east of England for road-making in towns, while the broken rubble is employed as macadam.

True *granite* is only found at Mountsorrel, where the rock is worked on a grand scale, about 700 men being employed. The "face" of the workings is more than half a mile long, and about 200 ft. in height. It is a conspicuous object from the Midland main-line, near Sileby. The other large quarries are in the *syenite* at Groby and Markfield, but smaller quarries are being opened at Cliff Hill, Garendon, &c. Owing to the hardness of the igneous rocks, they usually stand up as bosses or rounded hills, whose heavy curving outlines contrast strongly with the ridges made of slate, the latter being ever sharp, peaked and shivery.

On the Survey Map we find Bardon Hill and Birchwood Plantation shown as "greenstone," a term which appears to have been used by the officers of the geological survey for any rock which they believed to be igneous, but of whose precise nature they were not certain. So, too, all the ridge—three miles long—from Gracedieu to Green Hill is marked as "felspathic porphyry." In all these cases modern research—aided by the microscope—has shown these rocks to be volcanic ashes, now consolidated and greatly altered, but whose original nature is clearly discernible. Very similar beds occur in that division of the Pre-Cambrian strata of Wales to which Dr. Hicks has given the name of Pebidian, and which in North America are called the Huronian series. To this geological epoch, then, all the stratified rocks of Charnwood—the slates, ashes, grits, &c.—may be assigned; but with respect to the igneous rocks—the granite and syenite—we can only say, with certainity, that they must be *newer* than the slates through which they break. Possibly they, too, may date back to Pre-Cambrian times, but it is not improbable that their outburst may have taken place in the Lower Silurian age, which, in Wales and elsewhere, we know to have been a period of great plutonic and volcanic activity.

The granite of Mountsorrel consists of felspar (grey to pink in colour), quartz (glassy), mica (black), and hornblende (green). It is traversed by narrow dykes of felstone (a compact clear pinkish stone), and by a band of greenstone two yards wide (the "Great Fault" of the workmen), which Prof. Bonney has shown to be an altered dolerite, composed of felspar and augite.

The syenite at Groby and elsewhere is composed of the minerals, felspar, hornblende, and quartz. Just outside Brazil Wood is a knoll of a tough, dark rock (diorite), in which black hornblende is mingled with whitish felspar.

The syenite of Bawdon (Baldwin's) Castle possibly comes up through the faulted anticlinal. I found its junction there with a coarse grit. As the syenite nears the latter rock its crystals become smaller, and at the actual junction there is a thin band of the igneous rock almost as compact as glass. The difference is doubtless due to the more rapid cooling of the syenite where it was in contact with the grit. For the formation of large crystals a slow cooling is, as a rule, necessary. Altogether, Charnwood furnishes many difficult problems to the geologist, and much work yet remains to be done ere the intricacies of its rocks are finally unravelled. The publication—at no distant date, we hope—of maps of the region on the scale of six inches to a mile, will be a great aid to the student, who will be

XUM

enabled to lay down upon them with far greater accuracy than on the present "one-inch" maps, the facts which he ascertains about the strata.

CHATS ON GEOMETRICAL MEASUREMENT.

BY RICHARD A. PROCTOR.

THE HYPERBOLA AND PARABOLA.

(*Continued from p. 45.*)

A. In dealing with the ellipse and parabola, you determined (or rather, you showed me how to determine) the area of a segment cut off by any chord. Can you do the same for the hyperbola?

M. Let us see. Note first that our proof for the

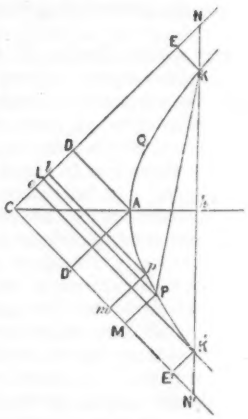


Fig. 3.

area between an asymptote, the curve, and two ordinates parallel to the other asymptote, applies equally whether the points from which ordinates are drawn are on the same side or on different sides of the axis. Thus if we draw (Fig. 3) two ordinates K E, P L parallel to C N′ to meet C N,

$$\text{area } P\,L\,E\,K = \text{par } D\,D' \log \frac{C\,E}{C\,L}$$

Hence if we draw the chord P K we get at once what you require; for we have

$$\text{Area } P\,Q\,K = \text{trap } P\,L\,E\,K - \text{par } D\,D' \log \frac{C\,E}{C\,L}$$
$$= \tfrac{1}{2}(K\,E + P\,L)\,L\,E \sin N\,C\,N' - \text{par } D\,D' \log \frac{C\,E}{C\,L}.$$

A. You use here the trigonometrical ratio, the sine; is that legitimate in geometrical work?

M. When we have come to use logarithms we need not stickle at the trigonometrical functions. Howbeit, the trigonometrical ratios are purely geometrical in origin and meaning. You no more take from their geometrical character by making them the subject of analytical processes, than you deprive a square of its geometrical character by showing that if the side of the square be a unit of length, the diagonal can only be represented by a non-terminating decimal.

A. In passing, I notice that the area between the hyperbola and its asymptotes is infinite.

M. Yes; for we can take C E as large as we please, so that wherever L be taken, the ratio C E : C L, and therefore $\log \frac{C\,E}{C\,L}$, may be made as large as we please.

A. What relation holds between such areas as A P K′ *e* D and A P K′ E′ D′, obtained by drawing ordinates A D, K′ *e* to one asymptote, and A D′, K′ E′, to the other?

M. A very simple one. These areas are equal.

A. Can this be easily proved?

M. Very easily, either from what we already know or independently. Thus we have learned that

$$\text{Area } A\,P\,K'\,e\,D = D\,D' \log \frac{C\,D}{C\,e};$$

and

$$\text{Area } A\,P\,K'\,E'\,D' = D\,D' \log \frac{C\,E'}{C\,D}:$$

but, since par *e* E′ = par D D′, and they have a common angle, we have C E′ : C D :: C D : C *e*

wherefore $\log \frac{C\,E'}{C\,D} = \log \frac{C\,D}{C\,e}$; and area A P K′ *e* D = area A P K′ E′ D′.

A. Is the independent proof simple?

M. Very simple indeed. From two adjacent points, P, *p*, draw the ordinates P L, *pl*, P M, *p m*. Then we have

par L M = par *l m*,

Wherefore par L *p* = par *m* P;

And these are corresponding elements of the two areas we are dealing with, A P K′ *e* D and A P K′ E′ D′. Therefore, these areas are equal.

A. Might you not have obtained the area A Q K L more easily from what you have just established, than by your former method?

M. More symmetrically, perhaps, but not more simply. Suppose we want the area K A K′, where K *h* K′ is perp. to the axis C A *h*. We have at once

$$\text{Area } K\,A\,K' = \text{trap } K\,E\,e\,K' - D\,D' \log \frac{C\,E}{C\,e}$$
$$= \triangle C\,N\,N' - \text{par } C\,K' - 2\triangle N\,E\,K - D\,D' \log \left(\frac{C\,E}{C\,D}\right)^2$$
$$= 2\left(\triangle C\,h\,N - \triangle C\,D\,A - \triangle N\,E\,K - D\,D' \log \frac{C\,E}{C\,D}\right)$$

as before.

A. Shall we now leave the conic sections?

M. First we may note another way of dealing with the parabola, suggested by a property of the tangent to the curve.

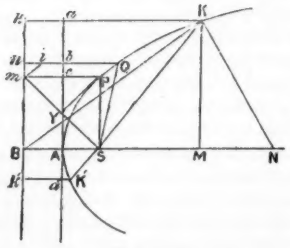


Fig. 4.

Let P Q, Fig. 4, be adjacent points on the arc A P Q, so that Q P Y is the tangent, ultimately, at P; A the vertex; S the focus; B A S M axial; K M perp. to axis; K *a k*, Q *b n*, P *c m* perp. to directrix, B *k*; A *c b a* the tangent at A. Join S P, S Q, S K, S *m* (cutting A *a* in Y), and draw *m i* parallel to P T. Then, since S Y = Y *m*, by well-known property,—

$$\triangle S\,P\,Q = \tfrac{1}{2} \text{ par } Q\,P\,m\,i;$$

but these are corresponding elements of the areas A P K S and A P K k B; for such areas as $m\,n\,i$ may be neglected compared with $m\,n$ Q P. Hence

Area A P K S = $\frac{1}{2}$ area A P K k B = $\frac{1}{3}$ trap B S K k.

This is a convenient relation. We may present it in another form. For, joining B K, and drawing normal K N (whence M N = 2 A S)—

trap. B S K k = $\frac{1}{2}$ M K (K k + B S) = $\frac{1}{2}$ M K (M B + M N)
= $\frac{1}{2}$ M K . B N = $\triangle$ B K N

$\therefore$ Area A P K S = $\frac{1}{3}\triangle$ B K N

Producing K S to meet the parabola in K′ and drawing K′ k' perp to k B k', we have

Area K P A K′ = $\frac{1}{3}$ trap K k k' K′.

(To be continued).

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XIII.—THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION—*(continued)*.

(v.) EVERY house ought to be furnished with an inspection-chamber, so situated that it cannot by any possibility be a source of nuisance. The chamber should be so arranged as to admit of ready access, and into it should flow the separate systems of waste drainage from the entire household, previous to their common exit therefrom by means of the principal house-drain. A well-regulated inspection chamber, then, would embody provision for the influx from (1) the soil-pipe, (2) the back-yard drainage, (3) the waste water from scullery and housemaid's sinks and wash-basins, where those conveniences obtain. To be theoretically as well as practically perfect, each of the systems should be most rigorously isolated; so that the domestic drainage may be compared to a valvate arrangement of tubes, each one separate from the others, each one destined to fulfil its own peculiar functions, and all of them to unite, after being duly trapped and ventilated, in the inspection-chamber. The very name of the latter savours, as it ought to do, pre-eminently of health, for it suggests that grand principle of sanitary reform which seeks to facilitate careful supervision, and affords scope for observation and experiment, thus enabling us to gain knowledge, the acquisition of which is now, as in the days of the ancient sage, power.

The inspection chamber may thus be viewed as the distal termination of the principal house drain, and through it all the excrementitious as well as harmless products are made to pass into the latter, with but one exception, and that is, although not all-important, yet very necessary to the intelligent display of the domestic drainage system, viz., the provision for the removal of front-area water. An open-trapped gully, with a suitable syphon-pipe and grease-disposing apparatus, should receive such innocuous waste and rain-water, and convey it to what may be called the proximal end of the house-drain. At this part another inspection-chamber must be added, and is technically termed the "man-hole." The man-hole should give free access to the house-drain as well as to the affluent pipe from the front-area gully: thus both the proximal and distal chambers of the house-drain afford their careful scrutiny when desired, and as that duct ought to be laid in a straight line between the two, it can be readily examined, and, if necessary, cleaned with the utmost ease throughout its entire course. The man-hole further furnishes easy access to the essential "disconnecting-trap" between the house-drain and the public sewer; and, to provide against possible accidents, the trap must be furnished with a clearing branch, down which a rod can be made to pass, in the event of an obstruction, which but rarely occurs, between the house-drain and the street-sewer. The man-hole, also, ought to be well ventilated by an inlet for fresh air, the *raison d'être* of which is to induce a current through the domestic-drain, and upwards along its main continuation (the soil-pipe), well over the chimney-stack by its ventilating head into the open air.

We cannot dwell too strongly upon the urgent necessity for the observance, to the letter, of the foregoing principles, since they seem to be everywhere violated, not only by the builder, who is devoid of any good training, but by otherwise well-educated but negligent persons, whose chief object is founded upon that pernicious commercial principle of erecting cheap buildings which shall afford a quick return, irrespective of whether they are sanitary abodes or the reverse. It is to these two sins of ignorance and avarice that the evils of the essentially-defective hydraulic system are mainly attributable. The escape of sewer-gas, whether it arises from bad workmanship or inferior material, is usually dealt with by the "patch" system; cases without number might be quoted in corroboration here, but at present they would be foreign to our purpose; we hope, however, to adduce evidences when we come to treat of structural examples, and *pro tempore* may direct our readers to that admirable institution, the Parkes Museum of Hygiene, where the wreckages, with their histories, stand as monumental warnings to the would-be sanitarian, and declare more eloquently than any mere words can do how important it is that we should be even hypercritical in these respects when exercising our choice of an abode.

We had intended, at the outset of these chapters, to leave the consideration of closet-furniture, as such, to a future occasion; but, on second thoughts, we deem it advisable to introduce that subject here in its right order of sequence as part of the fixtures in the framework of the dwelling-house. So, also, do the items connected with the house-drainage system, such as sinks, baths, &c., call for comment in this place.

With regard to the closet-trap, it is important that it should form part of the tubular system; that is, in the case of an upstairs closet, the trap ought to be part of the soil-pipe; and the joint, which is the weakest place, should lie between the closet-fixings and the soil-pipe, so that, in the event of an accident, the latter may yet be securely trapped and incapable of transmitting foul gas into the rooms of the house. In like manner, the basement closet-trap, for a similar reason, should form a part of the drain and not of the closet furniture. In all instances, the trap should afford absolute security from sewer-gas, and the ventilating arrangements should in every case find exit into the open air, away from windows, and where the escaping foul air cannot possibly cause any injury. The varieties of closets and their accessories now in the market are manifold; we shall hereafter give accurate descriptions of the best of those in general use, or about to be introduced, and point out carefully the faults of defective types of structure.

The waste-waters of the intra-household fittings are:—bedroom slops, scullery, pantry, and housemaid's slops, and dirty bath-water. Bedroom slops are usually emptied into the closet-basin, which should, therefore, in support of cleanliness, be provided with hinged lids. Sink and bath-water should be conducted to a receiving head, or a gully carefully trapped, and from thence through the inspection-chamber to the drain; in no case ought they to be connected with the soil-pipes, or with any part of the excrementitious conduits directly.

XUM

Whilst we were discussing the ash system for the treatment and removal of excreta, we noted that the one difficulty of any magnitude in the way of that method was its inadequacy in dealing effectively with house slops. We have since learned that the energies of Mr. J. Conyers Morell have been directed most successfully to the solution of this problem, and that he has overcome all obstacles by the adaptation of an apparatus to his ash-closet which can henceforward get rid of bedroom slops in such a way as to pass them on purified and quite harmless to the sewer. Our future illustrations will include a detailed sketch of all the useful and effective appliances in this department.

HOW TO TAKE CARE OF A TRICYCLE.

By John Browning.

Chairman of the London Tricycle Club.

LUBRICANTS AND RUST-PREVENTIVES.

WHEN you have got a good machine it is worth while to take care of it. Experience has taught me that there are very few, indeed, who know how to do this.

The most important point in preserving a machine is constant lubrication with an efficient lubricant.

Before we can determine what is the best lubricant, we must understand the principle of lubrication. Friction increases with velocity, but not with pressure, unless the pressure is so great that the lubricant is squeezed out. From this it follows that the thicker the lubricant the better it will act and the longer it will last. But pasty lubricants have this disadvantage, that they remain in the bearings, carrying with them particles of grit and abraded metal; while with a somewhat thinner lubricant these run out, and when a fresh charge of the lubricant is applied, they are washed out.

Vaseline is an excellent lubricator, but it is too thick, and when used alone it does not cleanse the bearings. The best way of using it is to add to it just sufficient good paraffin to make it run easily out of an oil-can. This compound acts admirably, and never hardens; the only objection I have to make to it is the smell of the paraffin, which is very distasteful.

Olive-oil may be used as a lubricant, but it is too thin, and after a time it hardens, forming a glutinous substance inside the bearings, and a horny substance outside the bearings, which can only be removed easily by using paraffin.

Pure sperm-oil is an excellent lubricant, because of its viscidity, but it is almost useless to recommend its adoption on account of the great difficulty of obtaining it free from adulteration.

By far the best oil to be obtained commercially is that known as Avila Tringham's Ruby Oil. This is rather thick, and has a pleasant smell. It is free from mineral oil, and it never hardens even on the outside of bearings. I have left a machine untouched through the whole winter, after freely oiling the bearings, and in the spring I was able easily to wipe away the oil which had exuded from the bearings with a piece of cotton waste. I have never found any other oil that I could purchase in bottle stand this test.

Most of the lubricating oils sold specially for the use of bicyclists or tricyclists consist of a vegetable oil, such as olive-oil or cotton-oil, mixed with a mineral oil—paraffin. They have all the same faults: they are too thin, and so run out of the bearings too quickly; and the mineral oil evaporates, and the vegetable oil hardens, as I have described.

If you wish to keep your machine in very perfect condition, it is a good plan to clean it yourself. Gardeners, coachmen, or other servants soon injure a light machine from want of knowledge of its construction and how to handle it. A tricycle can be cleaned most readily with oil. This instantly softens mud, and allows it to be removed without rubbing, and it does not carry the grit into the different bearings as water does.

I have found some of the cheap lubricating oils sold, in bottles holding about a pint, for a shilling, excellent for this purpose. It is, of course, rather an expensive mode of cleaning a tricycle, but it takes much less oil for this purpose than would be supposed. The rims of the wheels must, however, be cleaned with water, because oil softens and actually dissolves both the rubber tyres and also the cement with which they are attached to the rims.

Next in importance to lubricants are rust-preventers. Vaseline, applied with a hog-hair brush or piece of rag to either bright steel parts or nickelised work, is a great protection against rust; but Whittle's "Cycleum" is much better. Vaseline is easily rubbed off, and dust clings to it. Cycleum dries almost like a varnish, and so is free from both these objections. Even a thin coat of Cycleum, which has been nearly rubbed off, is a great protection, for a machine in this condition may be covered with rain and mud, and left to get dry without fear of its rusting. The chain may be protected by coating it with paraffin and blacklead, applied with a brush. I generally add a little vaseline myself, so as to get more body into the compound; though it has the disadvantage of holding dust. I consider it necessary to add vaseline if you give the chain only one application, but two or three applications of the paraffin and black-lead only will produce a coat of black-lead which will not hold dust, but will act as a lubricant and rust-preventer. Tringham's Tricycline, which is probably composed of paraffin-wax and plumbago, or fine blacklead, is better than the compounds I have named. It requires to be warmed before it is applied, but one application produces a fine hard coat which is a perfect rust-preventer, and an excellent lubricant. Either this compound or vaseline are excellent for the gear-boxes of double-driving motions, or two-speed gearings.

All the articles I have referred to above I have used many times; but many of them my friend Mr. Grace has experimented with, making the compounds himself, and combining them in various proportions. All the results he has carefully arrived at he has kindly placed at my disposal, for which I am greatly indebted to him.

WOODEN MAGNETS TO CURE DISEASE.

A CURIOUS example of the force of imagination is reported from Philadelphia. Dr. George C. Harlan, surgeon to the Wills Ophthalmic Hospital in that city, in the current number of the *Medical News*, reports a curious case, showing the great influence of the mind upon the body, and the beneficial effects of a wooden magnet upon both. A young Philadelphia woman, Lizzie D. by name, applied at the Polyclinic, Thirteenth and Locust-streets, for relief from a disease of the tonsils. She was treated by Dr. Solis Cohen. Her disorder was attended with hysteria, and, like all hysterical people, the idea of being doctored filled her with delight. Shortly after her initiation, the nervous symptoms became more and

more marked, and she was transferred to the care of Dr. Mills, the well-known neurologist. Five or six weeks previously she had had pleuro-pneumonia, and after that paralysis attacked the arms. This was cured, but the disease manifested itself in the legs and feet. Besides this there was a numb feeling in the lower part of the body, and twitching on the right side of the face, similar to that seen in St. Vitus' dance.

Dr. Cohen applied a Charcot magnet in front of the ear. To his amazement the spasms on the side of the face touched by the magnet were greatly lessened in frequency and extent. It was evident that the cure was the result of imagination. After that she was attacked with eye troubles. At first there was no defect other than headache, after the prolonged use of the eyes, and some shortsightedness, but at length the right eye became, apparently, entirely blind, and muscular spasms of the most violent character disturbed not only the eye, but the face and neck. She was sent to the Eye Hospital, and treated by Dr. Hansell. After several examinations, the Charcot magnet that had proved so efficacious in the hands of Dr. Cohen was applied to the defective vision, and with the most astonishing result. After many applications, it occurred to Dr. Harlan that it would be a good idea to try the effect of unmagnetized iron of the same form and appearance as the magnet. A wooden "magnet" was procured, with iron tips, to give the metallic impression to the skin. It was placed in the drawer where the original Charcot instrument had been kept, and the patient was thoroughly ignorant of its character. Before it was applied it was noted that the pupil of the right eye was widely dilated, as in disease, and was perfectly rigid when exposed to a bright light. There was twitching of the muscles of the right side of the face.

The application of the wooden magnet had a wonderful effect. Shortly after the painted wood was applied with much seriousness to her head, the twitching of the muscles stopped, and the face assumed its normal appearance. Gradually the pupil of the right eye became of the same size as the other, and freely responsive to light. The wooden magnet had triumphed.

Dr. Cohen a short time ago had a case where the wooden magnet proved its efficacy. A patient of his fell down, and thought she dislocated her elbow-joint. She was treated for that by a practitioner called in the emergency, and he discharged her with a stiff arm, which he said he was unable to straighten. Dr. Cohen examined the arm, and found no dislocation at all. He asked her to report at the surgical department of the Polyclinic for verification of his opinion. She called, and Dr. Steinbach noted extreme spasm of the biceps, the tendons being like whip-cords. Dr. Cohen applied a wooden magnet, and the spasm relaxed at once.—*Scientific American.*

NEWTON *versus* DESCARTES.*

AN ORATION IN DEFENCE OF THE NEW PHILOSOPHY.

(Spoken in the Theatre at Oxford, July 7, 1693, by MR. ADDISON.)

Done from the Latin Original.

HOW long, Gentlemen of the University, shall we slavishly tread in the Steps of the Ancients, and be afraid of being wiser than our Ancestors? How long shall we religiously worship the triflings of Antiquity as some do old Wives Stories? It is indeed shameful, when we survey the great Ornament of the present Age,* to transfer our Applauses to the Ancients, and to take pains to search into Ages past for Persons fit for Panegyrick.

The ancient Philosophy has had more allowed than it could reasonably pretend to; how often has Sheldon's Theatre rung with Encomia on the Stagyrite, who, greater than his own Alexander, has long, un-opposed, triumphed in our School-Desks, and had the whole World for his Pupils. At length rose Cartesius, a happier Genius, who has bravely asserted the Truth against the united Force of all Opposers, and has brought on the Stage a new Method of Philosophizing. But shall we stigmatize with the Name of Novelty that Philosophy, which, tho' but lately revived, is more ancient than the Peripatetic, and as old as the Matter from whence it is derived. A great Man indeed He was, and the only one we envy France.† He solved the Difficulties of the Universe, almost as well as if he had been its Architect. He destroyed those Orbs of glass, which the Whims of Antiquity had fixed above, brought to light that Troop of Forms till then unknown, and has almost extinguished the Element of Fire; nay he with so much clearness traced out the whole Mass of Matter, as to leave no occult Quality untouched. This Philosopher scorned to be any longer bounded within the Streights and Chrystalline Wall of an Aristotelic World; no, his Delight is to search the Regions above, to discover new Suns, and new Worlds, which lay hid among the Stars; his Satisfaction is to view that large Kingdom of Air amidst the unfixed Stars, and Lands that pass the Milky Way, and more accurately measure this vast Machine, a Machine fit for Mankind to Philosophize on, and worthy of the Deity, that first framed it.

Here we have not only new Heavens opened to us, but we look down on our Earth; this Philosophy affords us several Kinds of Animals; where, by the Help of Microscopes, our Eyes are so far assisted, that we may discern the Productions of the smallest Creatures, while we consider with a curious Eye the animated Particles of Matter, and behold with Astonishment, the reptile Mountains of living Atoms. Thus are our Eyes become more penetrating by modern Helps, and even that work which Nature boasts for her Master-Piece, is rendered more correct and finished. We no longer pay a blind Veneration to that barbarous Peripatetic-Jingle, those Scholastic Terms of Art, once held as Oracles, but consult the Delicates of our own Senses, and by late invented Engines force Nature herself to discover plainly her most valued Secrets, her most hidden Recesses.

By the Help of Instruments like these, that Air, with which bountiful Nature has indulged us, we as often as we please, by the Force of Art, abridge other Animals of, and keep them in our Pneumatick Pumps, from its common Benefit: What a Pleasure is it to see the fruitless Heavings of the Lights, to exhaust their Lives, and by a most artful Sort of Theft rob them of their Breath? From this nothing is safe, nothing so long lived, which gradually does not languish, and fall dead without a Wound. A divine Piece of Art this, and worthy its Author,‡ who in the Conduct of his Life, and the Force of his Arguments, has so nobly honoured our Nation, and the new Philosophy; one who for this Reason too deserves never to want the Benefit of his own Air, or that he, who has so often deprived other Animals of their Life, should ever breathe out his own.

On no such Grounds, as these has Aristotle built his Philosophy, who from his own Brain furnished out all his Rules of Arts and Sciences, and left nothing untouched on, nothing unregarded but Truth. If therefore he precipitated

* This oration will interest many who have noticed the references to the system of Descartes, in Fontenelle's lively dialogue on "Other Worlds than Ours."

* Newton. † Des Cartes. ‡ Boyle.

himself into the River Euripus, because he could not understand its Ebb and Flow, by the same Logic he might at his first Entrance on Philosophy have destroyed himself, and we may fairly doubt, in which of the Elements he ought to have perished.

After Aristotle's Fate amidst the Waves of Euripus, a new Race of Peripatetics started up, even worse than their Founder, who handed their Philosophy to after-Ages in so thick an Obscurity, that it has preserved it from the Satire and Ridicule of all Mankind, as understood by very few. Some there are to be found, who spend their Time amidst the Rubbish which these Commentators have filled the World with, and pore more than once on these God-like Treasures of Learning, and stick to them to no other purpose, unless to shew the World the vast Pains they take to be deceived. Can there be a more pleasant Sight than to see these wise Champions wrangling with each other? The one armed with Propositions and Syllogisms, attacks his Antagonist in the same Armour: Both Bell-weathers grow angry, and storm, fond of a Victory, which is worth but a Trifle, when obtained: Each, with all his Might, darts out his Barbarisms at the other, they entangle themselves in their Follies, and as neither knows how to extricate himself, they sound to a Retreat, and when all the Ammunition is spent on both Sides, they think fit to keep Silence.

Thus far, Gentlemen, and no farther, launches out the ancient Philosophy: Let us therefore sentence for ever this Troop of Commentators, to be tied up in Chains and Libraries, Food only for Moths and Worms, and there let them quietly grow Old, free from the Sight of any Reader.

THE BEGINNING OF LIFE.*

BY RICHARD A. PROCTOR.

M. BAILLY, the French astronomer (who perished on the scaffold in the French Revolution), wrote a book on the Atlantis of Plato, in which he strove to show that science had had its origin in high latitudes, if not actually round the North Pole. Of course he was unable to find the slightest evidence of any old system of astronomy in which the various relations corresponded to a pole-star nearly overhead. (What singular conditions would exist, by the way, at a North Polar observatory! At such a station the ordinary form of telescope, with its vertical and horizontal axes, would be an equatorial, simply because the vertical axis would be directed towards the pole of the heavens.) All Bailly could attempt to show was that the astronomical records of old times seem to retain traces of a system of astronomy belonging to a higher latitude than any passing through the Assyrian, Egyptian and Indian regions to which the origin of astronomy has usually been assigned. He showed some evidence in favour of latitude 50° north as having been that to which early astronomy belonged, though the evidence (as I have shown in appendix A, to my treatise on "Saturn and its System") was not nearly so decisive as he supposed. Now, if it can be shown that astronomy, which later had its chief schools in latitudes considerably south of 50°, had formerly thriven in that higher latitude, Bailly's main contention—that the progress of civilisation had been southward—would have been strongly confirmed. Traced back from 30° north to 40° and to 50° north, science and civilisation could be followed, independently of actual evidence, further north still, until at length the old Atlantis might in imagination be set around the North Pole itself. This would suggest to our modern students of the past, who go beyond the origin of civilisation to the origin of life itself, that all life came from the North Pole.

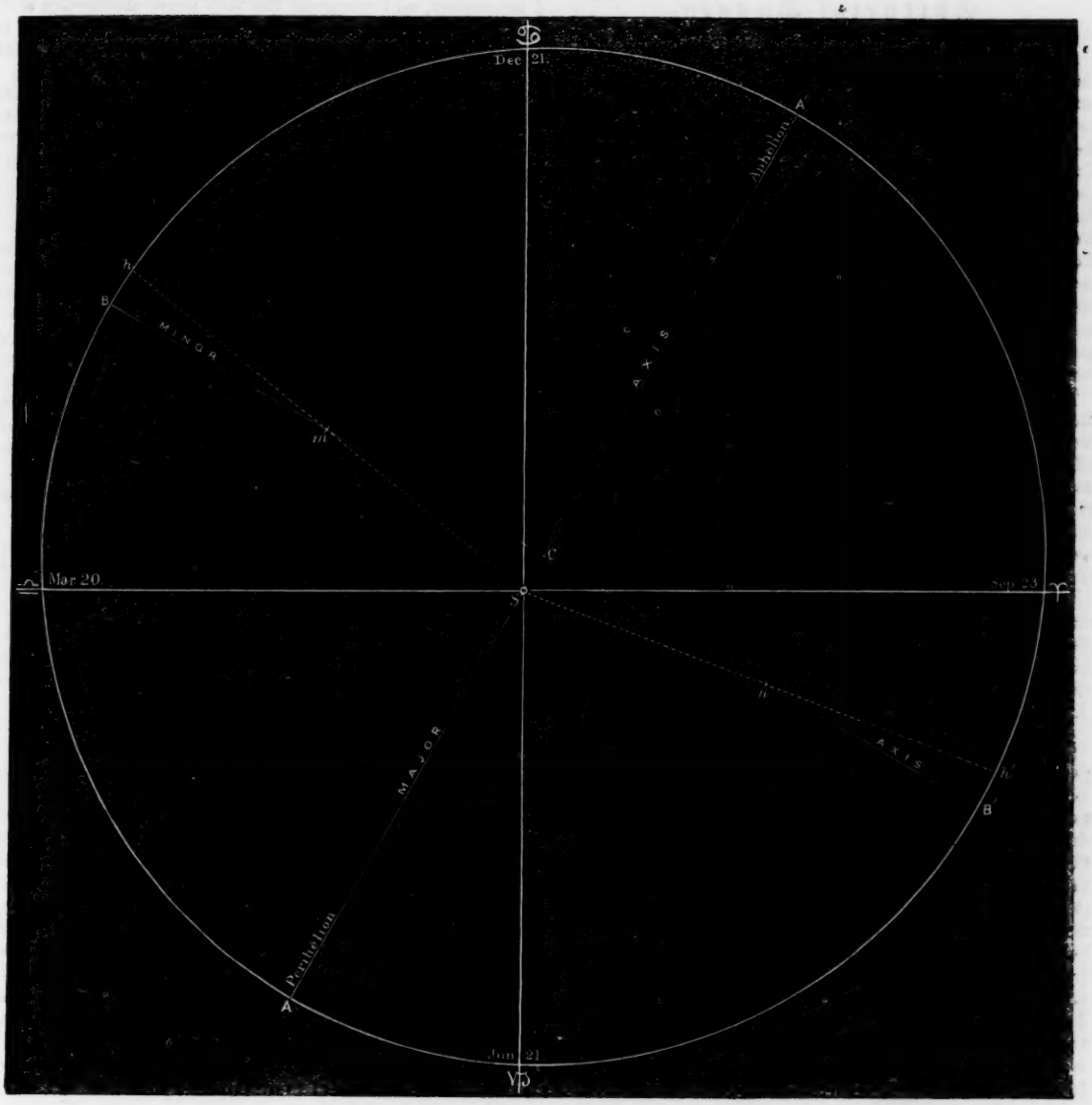
But if the North Polar regions early presented conditions suitable for the beginning of life upon this earth, it would seem reasonable to conclude that the South Polar regions would have been equally favourable for the first forms of life. In an interesting and suggestive letter in the *Tribune* of Friday, November 28, the Southern Polar regions are spoken of as originally more suitable than the Northern for life's commencement. The writer of that letter ("Tau Sigma") conceives that life had begun round the South Pole, and progressed some distance toward the equator, before life began round the North Pole. "Tau Sigma" bases this opinion on the actually existent relation between the position of the earth's axis and the direction of the line of apses—as astronomers pleasingly term the major axis of the earth's orbit. His words on this point are these: "If the relative position of the earth to the sun at the beginning of organic life on this planet was about the same as it is now (and we have no astronomical indications to the contrary) either the first suitable temperature, and consequently the first vegetable and animal life on the earth, occurred at or near the poles;" and later, "in this inquiry it must be taken into consideration, among other things, that the South Pole at the time of its midsummer in the earth's perihelion, is some three million miles nearer the sun than the North Pole at the time of its midsummer in the earth's aphelion." So far as can be judged, his whole argument is based on this consideration, and falls to the ground if this consideration is rejected.

In an able editorial article in the same number of the *Tribune* which contained "Tau Sigma's" letter, it was pointed out that this view "may not be generally conceded in the scientific world," nay, that "it is a scientific fact that the earth's perihelion is changing with the lapse of ages, and it is not entirely safe to assume that its relative position to the sun is the same to-day as it was when the beginning of organised life occurred."

These remarks are only open to exception as implying that there may be some doubt respecting the validity of "Tau Sigma's" position in this respect. As a matter of fact, astronomy would not only be unwilling to concede "Tau Sigma's" view, but would emphatically reject it. It is not only a scientific fact that the earth's perihelion is changing with the lapse of ages, but absolutely certain that the relation now existing between the apses and the solstices has been reversed and re-reversed several times since life began upon the earth.

Not to use technical expressions, the earth is now nearest the sun a few days after the midwinter of the northern hemisphere, which of course is the midsummer of the southern hemisphere. Thus, whereas the effect of varying distance from the sun partially corrects the effects of varying solar elevation with us in the North, these effects are intensified for the inhabitants of the southern hemisphere. We draw nearer by 1,500,000 miles to the central fire in midwinter, and recede as many miles from the fire in midsummer, the entire range of distance being about 3,000,000 miles; in the southern hemisphere they draw nearer to the fire in summer and recede from it in the winter. But this only for a while. In a few tens of thousands of years, which, in problems relating to the genesis of life are only as seconds, our northern hemisphere will behave as the southern hemisphere does now, and *vice versâ*. Not only so, but the range of distance, on which "Tau Sigma's" case in like manner depends, undergoes great variations. It has been many times in the past, and will

* From the *New York Tribune*, but corrected, extended, and illustrated for KNOWLEDGE.



ORBIT OF THE EARTH 850,000 YEARS AGO.

The points h and h' are those reached at the middle of the intervals between the passage of A, the aphelion, and A', the perihelion.

be in the future much less than it is now; while again it has in the past often been far greater than at present.

The figure is a picture of the earth's orbit, which I originally drew for an illustration to my article on astronomy in the "Encyclopædia Britannica." The orbit of the earth is represented as it was 850,000 years ago, at a time when it had very nearly its greatest possible eccentricity. Instead of the eccentricity being as now only about one-sixtieth, it was at that time nearly a thirteenth of the mean distance. In other words, instead of the earth ranging about 1,500,000 miles on either side of her mean distance, she then ranged about 7,000,000 miles from and toward the sun, making a total range of distance of about 14,000,000 miles. At that time then, very much more remarkable varieties of climate must have existed on the earth than now. Taking the distance when the earth was furthest from the sun, at her mean distance from the sun, and at her least distance, at 14, 13, and 12, the supplies of solar heat when the earth was so situated were as 11, 13, and 15, or—nearly enough—as 5, 6, and 7. So that when the earth was in perihelion she received 40 per cent. more heat than when she was in aphelion.

It so chanced that then, as now, the time of nearest approach to the sun occurred in the winter months of the northern hemisphere, (about December 1 instead of January 1); but that relation has several times been reversed since, and had been several times reversed before.

(To be concluded.)

AN American blacksmith has patented a cart having four high wheels, the horse being harnessed underneath. When going down hill the horse is raised by a broad belly-band, and so has a rest (?)

Editorial Gossip.

Everyone who is anxious for the diffusion of scientific information, and of the practical knowledge which that information brings, must be grieved to the heart at its prostitution by the skulking cowards who attempted to destroy the Tower, Westminster Hall, and the House of Commons on Saturday last. It is pitiable to find that the resources of modern chemistry have placed such a power for evil in the hands of the Irish-American scum, whose truculence is only equalled by their arrant poltroonery. The mischief is done now, though, and it only remains for peaceable, law-abiding citizens to consider how this form of atrocity can be best met. First and foremost, I would suggest, by a radical reform in our system of detective police. We must free our minds of cant, and not be led away by the bogey-cry that espionage is "Un-English." Why are not French public buildings blown up? Because there is a police-agent in every secret society in Paris. Secondly, the punishment of these vermin when caught should not only be as severe as it can be made, but as degrading. The burglar does risk his liberty and, even on occasion, his life. The dynamitard puts down his packet, lights a time-fuse, and runs away forthwith, leaving his deadly material to wreak destruction upon innocent men, women, and children. Nothing appeals to the feelings of such an arrant cur as this so immediately as personal physical suffering, and therefore severe and repeated flogging should form part of his sentence. As for the Rossas and Patrick Fords, they should be simply crushed under the iron heel of the mighty American Republic like slugs or blackbeetles.

The number of the *Monthly Notices* containing the papers read at the meeting of the Royal Astronomical Society on Dec. 12, 1884, reached us on Jan. 21, 1885—twelve days after the January meeting, and thirty-nine days after their presentation to the Society! The Christmas holidays may have had something to do with this most improper delay, but I suspect that a good deal of it was referable to the necessary press corrections of a particularly long and dreary paper by Dr. Gill, which probably has been read through by Mr. Stone only, skimmed by two or three more, and left absolutely unlooked at by an overwhelming majority of the Fellows of the Society. I consider that printing screw readings and the runs of the microscopes of a circle, *in extenso*, are an indefensible waste of the Society's funds. *Results* are what are needed in such cases, not mere *verbatim* copies of the observer's notes. If the money thus needlessly squandered were expended in additions to the Society's library, it must, and would, do almost indefinitely more to advance astronomy. Our governing body is, however, so largely composed of paid astronomers, that any official can get the contents of his observatory books reproduced *verbatim* in our proceedings without any difficulty whatever.

If, however, an undue proportion of the number of the "Notices," on which I am commenting, is occupied by the irksome pages of the Cape Astronomer, there is ample compensation to be found in one of the most novel, remarkable, and original papers that have been presented to the Society for many a long day. It is on "The Long Duration of Meteoric Radiant Points," by that well-known observer, Mr. W. F. Denning, who shows, upon evidence which it appears difficult or impossible to gainsay, that stationary radiant points of meteorites are visibly active during several successive months! Every reader of these lines, who has devoted the smallest attention to meteoric astronomy, will recognise the very grave difficulties which exist in reconciling such a phenomenon as this with the ordinarily received theories of the orbits of shooting-stars. Assuming it to be a fact, it must possess a meaning at present hidden from us. The elucidation of this meaning opens a fruitful field of labour, both to the observer and the theorist. All interested in the subject should at once procure Mr. Denning's remarkable essay, and read it carefully through, from beginning to end. It will well reward him for its perusal.

Encke's Comet has been picked up by several observers with moderate telescopes. The reader who may wish to realise its existing aspect can do so by making a circular slate pencil mark of about one-sixteenth of an inch in diameter on a slate, and then very nearly rubbing it out with his finger.

As a contribution to a sociological question of the gravest import, the following paragraph, which appears in the morning papers, seems to be worthy of very serious attention:—

> The Boilermakers and Ironworkers' Society in Govan, Glasgow, on Wednesday night, considered the offer of Mr. Pearce, of Elder & Co., to build a vessel of 5,000 tons, and give work to the unemployed, the conditions being that the same wages should be paid as in 1879. The society rejected the offer by 209 to 15. The ship will not be built, although thousands of men are idle.

Of course, it is quite within the competence of these people "to cut off their noses to be revenged on their faces" as long as ever their society support them, and no one has a right to quarrel with the decision they have arrived at in a matter concerning themselves. Should, however, any of these gentry apply in any shape or way for relief under the Poor Law, I do hope that the Glasgow Guardians will not lose sight of that very useful statute, 5 Geo. IV. c. 83, s. 3.

The "great gooseberry" season appears to have set in prematurely and with great severity in certain provincial journals. A correspondent writes to one of them, now lying before me, that he had a very old dog, which he much valued, and which, though suffering from the inevitable effects of age, he could not make up his mind to have killed. "On Thursday," he goes on to say, "I went towards the post-office with the intention of buying a dog-licence. I was just on the point of entering and planking down 7s. 6d., when my dog gave a loud bark and prostrated itself under the wheel of a heavy waggon. Death was instantaneous. The faithful animal, aware that its end was near, and wishful to save the expense of a licence, had voluntarily ended its earthly pilgrimage." Whether we regard this astonishing beast's Spartan indifference at once to death and to the exigences of Mr. Childers, or his practical method of exhibiting his affection for his master, we can only look upon the anecdote as Delicious.

Considering the endless variety of ways in which enjoyment can be derived from the pursuit of photography, and the simplicity of its processes under their altered conditions, it is not surprising that the practice of the art by amateurs is becoming fashionable; and were the facilities for acquiring a knowledge of so beautiful an accomplishment more generally known, the numbers of non-professional artists would doubtless be largely increased. The London Stereoscopic Company are doing much towards this end by their "free instruction" system (of which some hundreds of pupils have availed themselves during the past year), and at no very distant date we may expect to find the portable photographic apparatus, in its compact leather case, side by side with the gun-case, amongst the baggage of tourists; while no country house will be considered completely appointed without the necessary appliances for landscape photography. And every one "who is anybody" will probably soon consider it indispensable to be *au fait* with the use of the camera.

Reviews.

THE LEGENDS OF THE ALGONQUIN INDIANS.*

BY EDWARD CLODD.

THIS is a valuable addition to the trustworthy literature of Red Indian folk-lore. The accomplished author of the famous "Hans Breitmann Ballads," and of other humorous verse in hybrid dialects, has done larger service in exchanging his intercourse with dwindling nomads like the gipsies for researches among tribes whose traditions and folk-tales are found to exist in an unadulterated form; uncorrupted, too, by the foreign and modern elements which surround them.

Mr. Leland has not only taken down many of the tales from the Algonquins themselves, in whose memories there was no confusion apparent between what was and what was not pre-Columbian, but has confirmed his own work, and enriched his stock, by materials from sundry MS. collections of educated Indians and agents resident amongst the tribes. As in Mitford's "Tales of Old Japan" and Rink's "Tales of the Eskimo," native artists have increased the interest of this book, the reproductions of their "etchings" on birch-bark being characteristic and amusing.

The Algonquins were once dominant both in numbers and possessions among the aboriginal races of the St. Lawrence Basin. But that unending struggle in which through the whole range of animated nature only the fittest survives, has reduced them to a handful, and, surrounded as they now are by white men who have brought them into the fold of the Catholic Church, it is matter for both amazement and congratulation that there yet exists among them in oral form a far grander mythology than is found among the Chippewa and the Iroquois. It is from the North-Eastern Algonquins—the Passamaquoddy, Micmac, and Penobscot tribes that the myths, legends, folk-tales, beast-tales (of which some excellent and droll examples of the Uncle Remus type are given), and tales of magic, have been gathered by Mr. Leland, to whom, he tells us, "the old people declared that they had heard from their progenitors that all of these stories were once sung, that they themselves remembered when many of them were poems."

The materials of which these tales are compounded are familiar to the student of barbaric lore, the variety consisting in the different proportions of the ingredients. The central figure in the larger number of tales is the demigod or hero, Glooskap. He elects to come into the world like other folk, but his twin brother, the evil Malsumsis, "bursts through his mother's side," and thus causes her death. Both the brothers had charmed lives, and the crafty Malsumsis seeks in vain to learn the secret of Glooskap's vulnerability, but, revealing his own, is killed by Glooskap with a fern-root, which alone could slay him, as only the mistletoe could slay Balder. Glooskap is in all his achievements both human and superhuman; creator and culture-hero, he none the less enjoys his little jokes, and shakes with the laughter of the gods. He makes man by shooting arrows at ash-trees (which were typical trees of life, both among Norseman and Greek), when the Indians emerge from their trunks. He makes animals huge at the outset, but smaller by degrees as they one after another prove too strong for men. As culture-deity, he clears away the trees that man may till the soil, and teaches him how to hunt, how to build huts and canoes, and weirs for fish. "He the Great Master showed them the hidden virtues of plants, roots, and barks, and pointed out to them such vegetables as might be used for food, as well as what kinds of animals, birds, and fish were to be eaten. And when this was done, he taught them the names of all the stars. He loved mankind, and wherever he might be in the wilderness he was never very far away from any of the Indians. He dwelt in a lonely land, but whenever they sought him they found him. He travelled far and wide; there is no place in all the land of the Wabanaki where he left not his name; hills, rocks, and rivers, lakes and islands bear witness to him."*

Glooskap means the Liar; and he is thus ungratefully named because he has not redeemed his promise to return to the earth. The following extract from a Micmac legend, in which the story of his departure occurs, is a fair specimen of the stately and withal simple manner in which the tales are set down:—

"How Glooskap, leaving the World, all the animals mourned for him, and how, ere he departed, he gave Gifts to Men."

Now Glooskap had freed the world from all the mighty monsters of an early time: the giants wandered no longer in the wilderness; the *cullo* terrified man no more, as it spread its wings like the cloud between him and the sun; the dreadful Chenoo† of the North devoured him not; no evil beasts, devils, and serpents were to be found near his home. And the Master had, moreover, taught men the arts which made them happier; but they were not grateful to him, and though they worshipped him, they were not the less wicked.

Now, when the ways of men and beasts waxed evil, they greatly vexed Glooskap, and at length he could no longer endure them, and he made a rich feast by the shores of the Great Lake Minas. All the beasts came to it; and when the feast was over he got into a great canoe, and the beasts looked after him till they saw him no more. And, after they ceased to see him, they still heard his voice as he sang; but the sounds grew fainter and fainter in the distance, and at last they wholly died away; and then deep silence fell on them all, and a great marvel came to pass; and the beasts, who had till now spoken but one language, were no longer able to understand each other, and they fled away, each his own way, and never again have they met together in council. Until the day when Glooskap shall return to restore the Golden Age, and make men and animals dwell once more in amity and peace, all nature mourns. And tradition says that on his departure from Acadia the great snowy owl retired to the deep forests, to return no more until he could come to welcome Glooskap; and in those sylvan depths the owls even yet repeat to the night, "Koo-koo-skoos!" which is to say in the Indian tongue, 'Oh, I am sorry! Oh, I am sorry!' And the Loons, who had been the huntsmen of Glooskap, go restlessly up and down through the world, seeking vainly for their master, whom they cannot find, and wailing sadly because they find him not."‡

In the above account of the confusion of speech among beasts there is the underlying barbaric belief in community of nature between them and man, which is due to totemism, for, as another Micmac legend says: "In old times; in the beginning of things, men were as animals, and animals as men; how this was, no one knows." In a Passamaquoddy legend Glooskap's totemic name is Black Cat; Mikchich, another hero's name, means the Turtle; and in the boy whose totem name was the Sable, and who has a flute, the player of which could entice to himself all the animals, we

* "The Algonquin Legends of New England." By CHAS. G. LELAND. (London: Sampson Low & Co. 1884.)

* The author has the following footnote—"This is from the Ranch manuscript. The writer remarks that these expressions were the very words of a Micmac Indian named Stephen Flood, who had no idea that he was using almost the identical expressions of Holy Writ with reference to God."

† The Chenoo, about whom Mr. Leland has collected legends (*vide* pp. 233-254), is a terrible cannibal with a heart of ice, which is a replica of the monster, and which adds another "soul" to the victor who swallows it.

‡ pp. 66-68.

have a variant of Orpheus, whose lyre charmed trees and streams to follow him in his wanderings; of the Finnish hero Wäinämöinen, whose music gave warmth to sun and moon, and lulled a whole people to rest; of Sigurd, with his magic harp; of the lyre of Glenkundie, "Who'd harpit a fish out o' saut water, Or water out o' a stane, Or milk out o' a maiden's breast That bairns had never nane."

Throughout this work, especially in the tales of magic, the animistic element in barbaric belief receives further confirmation. In the "Merry Tales of Lox" (the mischievous and crafty devil of the Red man, who rose from the dead), the stars are living creatures, weasels and other animals become their brides; the thunder and the lightning are brothers who shook at "the enemies of their friends" with thunder-bullets which the Indians keep for good luck, as our rustics kept flint arrow-heads or "elf-darts" as charms; the Wind-Spirit is chained, like Prometheus, to a rock, and his struggles cause the storms to rage and the earth to tremble; the spirits of the corn, the beans, and the squashes are sisters, and there are spirits in every tree and herb, "in tobacco, and in the grass." As the outcome of this is the belief that every event in life is due to these obscure agents, and that only the priest or doctor—Shaman or medicine-man—can control their action, defeating it by counter-charms, or aiding it by sorcery. This power over the invisible, and therefore over their fellow-creatures, which the *m'-teoulin*, or magicians, assume, is acquired by long and painful training—some among them, however, being to the manner born. They would find nothing new in Theosophic circles or among Esoteric Buddhists, for their "astral souls" can annihilate space and time, and confer with their fellows regardless of distance.

The frequent coincidences between the Algonquin and the Eddaic myths cause Mr. Leland to incline towards a theory which refers them to Scandinavian sources through Eskimo channels. The Eskimo have a history outside their present narrow zone. Some pre-historic archæologists hold that they are the descendants of the Reindeer men of Western Europe in the latter part of the Ancient Stone Age; ethnologists see evidence of their former presence in Japan, and, within comparatively recent times, they ranged as far south as Massachusetts. Mr. Leland adduces some striking resemblances between the Norse and the American Indian cosmogonies and eschatologies (pp. 27, 133 f.f.), and the arguments in support of the indebtedness of one to the other are not to be refuted. Neither are they to be too hastily adopted, because against such resemblances, which can be paralleled in the myths and customs of the most remote peoples, as *e.g.*, the ancient Romans and Peruvians, there is always to be set the fact of the like behaviour of the mind in presence of like phenomena, and the relativity of the former in the explanations which it gives of the latter.

But the question, which is, after all, not of prime importance, must remain unsettled.

Enough has been said to show that Mr. Leland has furnished a rich treat, ungarnished by foreign dressing, in these Algonquin tales, and therefore to bespeak for them a welcome from students of folk-lore on both sides of the Atlantic.

As showing that the Algonquin Æsop has not always omitted the moral, the following preface to a beast-fable may conclude this notice:—

"Don't live with mean people if you can help it. They will turn your greatest sorrow to their own account if they can. Bad habit gets to be devilish second nature. One dead herring is not much, but one by one you make such a heap of them as to stink out a whole village."

SOME BOOKS ON OUR TABLE.

What to do with our Girls. By A. T. Vanderbilt. (London: Houlston & Sons. 1884.)—As long as Mr. Vanderbilt bears the sound old maxim "Ne sutor ultra crepidam" in mind, he has something to say, in connection with female employment, which is worth listening to. His bombastic political exordium, however, with the democratic and isn't-everybody-as-good-as-everybody-else tone pervading it, might well suffice to deter readers from proceeding to the perusal of what is really useful and practical in the book. Women in search of work will find a mass of detail concerning the various female occupations pursued in England. By the bye, "Caucus-mongering" (p. 115) strikes us as a novel one.

Odds and Ends of Useful Knowledge. By a Lady. (London: Relfe Brothers.)—The Lady is a schoolmistress, and she has jotted down a variety of facts and dates in history, geography, science (such as it is), and literature. Doubtless use might be made of a book like this in preparing for some of the simpler forms of examination; but what opinion can we form of the amount of information possessed by a teacher who tells us that "the seven sciences" are "geology, geography, astronomy, astrology (!), mathematics, botany, and zoology"?

The Woodford French Book. By G. F. H. Sykes, B.A. (London: Relfe Brothers.)—This is, in effect, a series of reading lessons in French, founded on Larousse's "Méthode Lexicologique de Lecture," and intended to teach English children correct pronunciation. Incidentally, some French grammar is introduced. As far as we have been able to test Mr. Sykes's little book, it seems well adapted to its purpose.

Britannia Magna. By the Alderfirst of Ababrelton. (London: Wyman & Sons. 1884.)—We were for some time in doubt whether "the Alderfirst of Ababrelton" (whatever that title may represent) was not poking some clumsy fun at his readers. Upon reconsideration, however, we have come to the conclusion that this occult dignitary is really serious in supposing that the mighty British nation will consent to "reform" its constitution by—changing the names of its component elements, and creating titles which sound as though they came out of the opening of a Christmas Pantomime. To give a single example, the author suggests that a Baronet's eldest son should bear the title of a "Nobling!" Whether a cobbler's first-born should be called a "Snobling" he omits to state. It is, however, when he comes to deal with the United Services that he exhibits his terrible unfitness to teach anybody. If he knew anything whatever of the army, he would be aware that, in nine cases out of ten, to give a sergeant a commission is to present him with a white elephant. He seems to think, too, that "brigadier" is a military rank in the same sense that lieutenant-colonel or major-general is, and that a regiment and a battalion are different things. So, again, in the navy, he obviously believes that captains and commanders are of inferior rank to staff-captains and staff-commanders, the fact being that these last are non-combatant officers promoted from the navigating-lieutenants (the old "masters" of a past generation). It is just as well for an author to acquaint himself with the rudiments of his subject, while he is about it, before presuming to instruct others.

Magic Lanterns: How Made and How Used. By A. A. Wood, F.C.S. (London: E. G. Wood).—Amid the rather numerous magic-lantern manuals which have recently appeared, we have seen none fuller or containing more varied and useful information than the profusely-illustrated *brochure* of Mr. Wood. On lines 5 and 6 of p. 44, though,

occur directions which, if literally followed, might put a summary and eternal stop to the use of the lantern by the experimenter. It looks like, and probably is, a stupid printer's error.

Roman History. By Rev. B. G. JOHNS. New Edition, with an Appendix by Rev. T. H. L. LEARY, D.C.L. (London: Crosby Lockwood & Co., 1884.)—As an introduction to Roman History for school-children, the little book before us seems to fulfil its end very well, telling the familiar but wonderful story of the mighty empire of old in a series of short and simple chapters. Dr. Leary contributes an Appendix on the Literature, Laws, and Customs of Ancient Rome, treating these subjects in a similar manner.

We have also on our table *The Tricylist, Bradstreet's, The Journal of Botany, Our Monthly* (Rangoon), *The American Naturalist, The Medico-Legal Journal, The Medical Press and Circular, Packard's Shorthand Reporter* (New York), and *The Dyer.*

THE FACE OF THE SKY.

FROM JAN. 30 TO FEB. 13.

BY F.R.A.S.

THE Sun continues to exhibit spots and groups of spots, and should be examined with the telescope whenever the sky is clear. The aspect of the night sky is shown in Map II. of "The Stars in their Seasons." For all practical purposes, Mercury, Venus, and Mars may be regarded as invisible. Jupiter is now fairly placed for the observer during the greater part of the night, though he does not cross the meridian until the early morning. He is situated to the east of, but is approaching *a* Leonis, and is a brilliant object in the night sky. The following are the phenomena of his Satellites which will occur before 1 a.m. during the succeeding fortnight. On Feb. 2, Satellite IV. will disappear in eclipse at 10h. 8m. 28s. p.m.; the shadow of Satellite I. enters on to Jupiter's face at 11h. 48m., and Satellite I. itself 12 minutes after midnight. On the 3rd, Satellite I. will be eclipsed at 9h. 1m. 54s. p.m., to reappear from occultation at 11h. 41m. At 12h. 9m. 27s. Satellite II. will disappear in eclipse. On the 4th, the shadow of Satellite I. will begin its transit at 6h. 17m. p.m., as will the Satellite casting it at 6h. 38m.; but the observation of these is doubtful. The shadow will pass off at 8h. 37m., the Satellite at 8h. 57m. On the 5th, the shadow of Satellite II. may possibly be seen to enter on to the planet's limb at 6h. 32m. p.m. The ingress of Satellite II. itself will be visible at 7h. 13m. The shadow will pass off the opposite limb at 9h. 28m.; followed by the Satellite at 10h. 8m. On the 9th, Satellite III. will re-appear from behind Jupiter at 7h. 53m. p.m. On the 10th, Satellite I. will be eclipsed at 10h. 55m. 31s. On the 11th, the shadow of Satellite I. begins its transit at 8h. 11m. p.m., followed by the Satellite at 8h. 22m. The shadow passes off at 10h. 31m.; the Satellite at 10h. 41m. Lastly, on the 12th, Satellite I. re-appears from occultation at 7h. 51m. p.m.; the ingress of the shadow of Satellite II. occurs at 9h. 6m., and that of Satellite II. twenty minutes later. The shadow leaves the planet at 12h. 2m.; the Satellite itself at 12h. 21m. Saturn is still a beautiful object, remaining almost sensibly stationary in the position described on p. 56. He should be observed not later than 9 p.m., to be seen at his best. Uranus is to the east of η Virginis. The Moon is full at 4h. 19·2m. this afternoon, and enters the last quarter at 10h. 37·6m. on the night of Feb. 6. Three occultations only of stars will be observable at convenient hours during the next fourteen days. To-night (Jan. 30), the 6½ mag. star, B.A.C. 3122, will disappear at the bright limb of the Moon at 8h. 54m., at an angle from her vertex of 30°; reappearing at what looks like her other bright limb at 9h. 59m., 237° from her vertex. On Jan. 31 she will rise with π Leonis (of the 5th mag.) actually behind her; but the star will be seen to reappear at her dark limb afterwards at 6h. 35m. p.m., at a vertical angle of 255°. On Feb. 1 another 5th mag., star *d* Leonis, will disappear at her bright limb at 8h. 1m. p.m., at a vertical angle of 31°, reappearing at her dark limb at 8h. 57m., at an angle of 218° from her vertex. The moon is in Cancer when these notes begin, but at 3 a.m. on the 31st crosses into Leo. At 9 a.m. on Feb. 1 she descends into Sextans, re-emerging in Leo at 4.30 p.m. the same day. She quits Leo for Virgo at 4 p.m. on the 2nd. In Virgo she remains until 9 p.m. on the 5th, when she enters Libra. Across this she travels until 10 p.m. on the 7th, crossing at that hour into the northern strip of Scorpio, which it takes her nearly 12 hours to pass over. Having done so, she moves into the southern part of Ophiuchus. At 4 a.m. on the 10th she passes into Sagittarius, which, at 9 p.m. on the 12th she quits for Aquarius. There we leave her.

Miscellanea.

AT last Friday's meeting of the Metropolitan Board of Works, Capt. Shaw presented his report on the fires in London during 1884, which showed an increase in number of 145 upon the previous year, and 531 above the average of the last ten years. The number of lives lost was 42.

THE NEW YORK ELEVATED RAILROAD. — The necessary agreements and contracts relative to the amalgamation of the several electromotor interests for the elevated railroads in New York will be signed upon the same table and in the same room where the contract for the first Atlantic cable was signed, March 10, 1854, and Mr. Cyrus W. Field will represent one of the parties in each instance.—*Engineering.*

FROM a report by Professor Church, of the Agricultural College at Cirencester, it would appear that sugar beet was grown successfully in England during the hot and dry summer of the past year, ordinary root crops (such as mangold-wurzel, &c.), having been, as is well known, exceedingly deficient. As wheat, at its present price, is wholly unremunerative to the farmer, the cultivation of the sugar beet would appear to open up a possible source of comparative prosperity to him.

ANOTHER TELEPHONE ACTION.—The "New Telephone Company," owning the patents of Professor S. P. Thompson and Mr. Jolin, is threatened with litigation by the United Telephone Company, owning the Edison and Bell patents, on the ground that the "valve telephone," advertised for sale by the former company, is an infringement of their rights. If the suit comes on, the whole question of the scope and powers of the Edison and Bell patents in this country will probably be raised again.—*Engineering.*

ENCOURAGED apparently by the success of their work, entitled, "The Royal Academy Illustrated," the first volume of which appeared last year, we hear that Messrs. Chapman & Hall are not only going to issue a corresponding volume during the present one, but propose to supplement it by a second one, entitled, "Not Hung at the Royal Academy, 1885," containing a selection from the *rejected* paintings, the sketches for which will be published under the authorisation of the artists. This will afford the public an opportunity of judging between the great unappreciated and the Royal Academicians.

THE following abstract of a paper read at the meeting of the Geological Society, on Jan. 14, will be read with interest in connection with the article by Mr. W. Jerome Harrison, which appeared on p. 337 of our second Volume:—"3. 'The Drift-deposits of Colwyn Bay.' By T. Mellard Reade, Esq., F.G.S. The author, after referring to a former paper ('Quart. Journ. Geo. Soc.,' vol. XXXIX., p. 111), described the drifts of Colwyn Bay as forming cliffs towards the sea, and thinning out inland, forming a crescent-shaped deposit, which lies for the most part upon Silurian rock of Wenlock age, while the two headlands of Colwyn Head and Rhos Point are denuded remnants of Carboniferous Limestone. He distinguished three divisions in the drifts:—1. Bluish-grey Till, composed of disintegrated Silurian and Carboniferous rocks, and full of striated fragments of slaty rock, with few granite boulders; its surface is unevenly denuded. 2. Brown Boulder-clay representing the Low-level Boulder-clay and Sands, overlying the former, evidently a marine deposit, and containing shell-fragments. To this bed the author referred most of the erratics found on the shore, which included boulders of Eskdale and Scotch granites; and 3. Rearranged gravels. The line of demarcation between numbers 1 and 2 is particularly clear. The author considered the Bluish-grey Till to be here, as elsewhere, chiefly, if not entirely, made up from the denudation of the local rocks, the material being brought down by the action of ice and snow from the high ground lying inland; while the overlying deposit of brown Boulder-clay is part of the great sheet of Low-level boulder-clay and sands which occupies the plains of the north of England from the mountains to the shores of the Irish Sea, and, like the more sandy boulder-clays near Liverpool, its materials were probably derived chiefly from Triassic rocks, which occur in the neighbouring Vale of Clwyd, mixed with material derived from other rocks, and especially with argillaceous matter from the underlying till. The granite boulders contained in it were carried to where they lie by floating ice."

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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MATTER.

[1572]—Your short answer to my last completely meets the case; certain theories are received more readily by some minds than by others.

Mr. Routledge (letter 1,564) does not consider Hæckel's statements logical. I can only say this is a matter of opinion on which I differ from him. If Mr. Routledge applies Prof. Clifford's "Ethics of Belief" to Hæckel's statement, saying, "How can Hæckel, or anybody else, adduce logical evidence that atoms during the eternity that is past and the eternity of time that is to come," &c., let him also apply it to Du Bois Raymond's dictum, which Mr. Routledge considers more reasonable. Hæckel, at all events, confines his statement to the properties of atoms as they appear to his mind "at present"; but Raymond dogmatically predicates on the past, present, and future nature of atoms, assuming the position of the prophetic seer, who declares to us what is "absolutely and for ever inconceivable to us." I can only call this slamming the door into the face of all inquiry after truth. Does not Mr. Routledge see that he swallows the camel of Raymond whilst straining at Hæckel's gnat? If Mr. Routledge acknowledges being attracted, unconsciously, by the earth, perhaps he will on searching find that he also has unconscious likes and dislikes. At all events, do we not say that plants like warmth, light, and certain soils—do they do so consciously?

F. W. H.

OBSCURUM FACERE PER OBSCURIUS.

[1573]—In the interest of scientific truth and sober criticism, I shall be obliged by the insertion of this curt minute on the "short and sweet" review of the tract: "What is Religion?" in KNOWLEDGE of January 16.

It is there airily stated that the "*Ego* and *non ego* are here once more warmed up; that the universe must be held to consist of Dr. Lewins' sensations"; ending with the remark, "We seem to have heard something remarkably like this before." Now I quite confess the latter soft impeachment, which reminds me of Gretchen's parallel between the priest and Faust's views about Deity. There is really nothing absolutely new under the sun. But similarity is not identity, and the utilisation of a few handy metaphysical shibboleths by no means implies that the idea conveyed by the term "Brain theory of mind and matter" is that of Messrs. Berkeley, Hegel, Fichte, &c., but *vice versâ*. My view is a strictly physical and physiological, not a metaphysical, one; quite within the limits of research, and may well be termed Neo-phrenology. It is entirely materialistic or humanistic. It reproduces the Protagorean Hylozoism that each sentient being is its own universal standard, and thus gets rid entirely of the *nous* the above ontological gentry, as also your able contributor Mr. Cave-Thomas, introduce, as the *primum mobile*, altogether. This somatism resolves, or dissolves, all things into intercranial concepts, of which brain is the protoplasm, or *officina*, and thus may be said to reduce all knowledge to a system of cerebral semeiotics. The macrocosm, as an object of consciousness, is thus the content of the microcosm, the seat, or rather creator, of consciousness. All natural law, including gravitation, on which so much solemn and elevated eloquence is expended in the same number of KNOWLEDGE, is a law, not of "external," but of our own nature—true "externality" having for us no real existence whatever—*veræ causæ*, or actual œtiology, lying in regions to which the mind has no access, and, therefore, as good as non-existent. The relative, or phenomenal, sphere bounds human vision, and Newton's law only rationalises, in no degree "explains," the principle of motion, each self, and not an exoteric "*nous*," or nature, being man's *primum mobile*, which he can only know by sensation—a natural function of his own, and of nothing else. Coleridge well says, wide as he departs from the spirit of the canon in his "Spiritual Philosophy,

"We receive but what we give,
And in our life alone does Nature live."

In late numbers of the *Journal of Science* are some more explicit papers and letters of "C. N." and myself on this argument. Certainly both of us are under the impression, spite of our having used some familiar metaphysical nomenclature, that our view is a complete change of front from that of either English or German transcendentalism.

ROBERT LEWINS, M.D.

Army and Navy Club, Jan. 17.

[Whether the perusal of Dr. Lewins's letter will induce the reviewer of "What is Religion?" to modify his criticism I regard as in the last degree doubtful; I rather insert it that others may obtain an idea of the nature of the hypothesis to which the notice on p. 56 has reference.—ED.]

THE ORIGIN OF MYTH.

[1574]—A series of articles on dreams and myths have lately occupied your pages, in which Mr. Clodd has collected many facts of the greatest interest which go far to show that the notion of a soul or shade distinct from the body has been among many primitive peoples an inference from the phenomena of dreams.

These articles have also contained a number of speculations and assertions more or less remotely connected with their ostensible subject, in which the author appears to assume:—

1. That belief in a soul can never have had any other foundation than that to which he refers: the fact being that, so far as I am aware, no philosopher in ancient or modern times who has believed in a soul has rested his belief on dreams.

2. That, if dreams are an insufficient basis for the belief referred to, it must necessarily be erroneous.

3. That the existence of a distinct soul is a necessary condition precedent of a future life.

4. That science deprives us of the hope of an hereafter, but gives us more than its equivalent in return.

It seems to me that our belief in a future life must consist in reliance on the wisdom and goodness of God.

If the Supreme Being, the Eternal Energy (to use Herbert Spencer's phrase), the one First Cause (whose existence, universality, and power are evidenced by the *uniformity* of the laws of nature) be wise enough (as I believe He is) to know all the sorrows and aspirations of His creatures, how sad the lives of many of them are, how little relieved by happiness, how often, when the brightness seems to be coming at last, it is forestalled by death; and if He is righteous enough (as I believe He is) to feel for them and give that elsewhere which they have vainly longed for here, then there *must* be a life to come.

Shall we, His children, deny to the All-Father knowledge and goodness? Surely, never, unless we have *absolute* proof of His want of those qualities; and that could never be, unless we had a *certainty* that there was no future life.

When this present life has ceased, and our earthly body has become useless to us, God (if He is such a God as we have a right to believe Him to be) will give us a new bodily frame which will preserve to us our own thoughts and sympathies, just as science tells us He has done many times in the lives of most of us. Whether our personal identity includes what is termed a soul (as I think, for reasons I need not detail here), or consists solely of our characters, memories, and associations, that identity can be preserved as much after death (if God so will) as it has been through all the physical changes of our bodies since our childhood.

No man loves science more than I do—its beauties, its surprises, and its grandeur, and few have spent more time in their study and pursuit; but, if I were robbed of my belief in a life to come, how could these, much as I value them, compensate me for the loss of those dearer to me than life, from whom death will one day part me, or has parted me already, and yet the awful feeling that there is no justice or mercy to be looked for from above? But I am happy to feel that my belief rests on nothing that science can take away. With regard to the letter of "F. W. H." He says that the can't understand how a human will can coexist with a universa will; is it incomprehensible that God should wish us to be able to exercise our wills so as to influence (by means of our bodily frame) surrounding circumstances, and that He should accordingly exercise His will so as to give effect to ours?

Again, we may correctly say that anything happens from natural causes when it is the result of the operation of the laws and customs

according to which God has (in general) chosen to exercise His will; and we may legitimately call anything an accident when it is the result of the exercise of a man's will on his surroundings, but which was not intended by him. I can see no real objection to these phrases, even in the mouth of one who believes that nothing happens without the will of God. AN EARNEST THINKER.

[It is to be regretted that our correspondent is not a careful, accurate, and logical thinker, as well as an "earnest" one. Mr. Clodd has never for a single instant asserted that any "philosopher in ancient or modern times, who has believed in a soul, has rested his belief in dreams." That the remote and savage progenitor of that philosopher did so is a very different thing indeed. Moreover, the "Thinker" (?) trespasses so on the confines of Theology that my first impulse was to exclude his letter altogether; and I only ultimately decided to insert it to show the strangely inconsequential kind of declamation which some people mistake for argument. What becomes of "the uniformity of the laws of nature" if we are to accept the definition of an accident contained in "An Earnest Thinker's" peroration, I rather fail to see.—ED.]

"OUR TWO BRAINS."

[1575]—How is it possible to prove another unconscious? I only remember one occasion, except during sleep, on which I was unconscious for any period of time. I was about twelve years old, and was playing cricket on the Brighton Downs. A ball was hit down a very steep hill, and in running after it I tripped up, and, falling heavily, was stunned. As I did not get up immediately, two of my companions came to my assistance, and, finding I had rather damaged my limbs, helped me up the hill. Meanwhile play was stopped, and we all walked homewards. When about a mile on the road thither I suddenly came to my senses and asked where I was, to the surprise of my companions, who had not had the slightest idea I had been unconscious. They say I had talked the whole time perfectly reasonably. I often wonder, if I had remained unconscious, whether any one would have found it out.

In the cases lately recorded in KNOWLEDGE in the papers on "Our Two Brains," as dual consciousness, is there any proof that in the abnormal state the subject is conscious? Let us take the case of the boy at Notting Hill. It is true he acts as if he were conscious, but when he comes to what may be considered his ordinary state of consciousness, he seems to be exactly in the same state as the man, who, recovering from the effects of an anæsthetic, under which he cried out he was being hurt, says he felt nothing. As the abnormal life of the boy only lasted about a couple of hours every day, it must have been a very peculiar one. Fancy life without breakfast or five o'clock tea, and dinner only occasionally!

But, turning to the case of Sergeant F., we find that for three weeks after his accident he was unconscious; unable, I suppose, to speak or move. Then for three months he was conscious, and in his normal mental condition, but paralysed. But at the end of these three months an abnormal state occasionally takes the place of the normal mental condition. The left brain has been injured sufficiently to cause paralysis of the right side, which at this time still continued, but, according to the "two-brain theory," it is sufficiently sound to do all the brain-work done during the abnormal state. Surely it is the right brain acting abnormally which produces these abnormal results. It is a well-known physiological rule that in all dual organs should one half become diseased or useless, the other half gradually takes up its work, and this is probably true of the brain. It seems to me a fatal objection to the "two brain theory" that in some cases, which it seems to explain, the two brains act like buckets at a well—one in and one out. Even if the right brain should suddenly become ineffective, why should the left brain almost immediately begin to act? Why should the left brain cease to act when the right brain recommences? Would not occasions frequently arise when both brains would act together, when the events of both lives would be remembered at the same time? I mean especially in such cases as that of the boy at Notting-hill. Even taking for granted that the left brain regulates the actions of the right side, and *vice-versâ*, is it necessary to suppose we are conscious of sensations on the right side in the left brain, and of those on the left side in the right? Is not consciousness the sum total of all the sensations recorded by every part of the brain? and if we admit a separate consciousness for each half of the brain, is there any reason why we should not divide the brain up into fifty parts, and admit a separate consciousness for each part? After severe mental work in India, my right side frequently went what is called to sleep; but I was quite as conscious that my right side was asleep as that my left side was not. The drunken man's double vision is sometimes explained by the "two brain theory;" but does not the drunken man really see two moons? I see colours different shades with each eye. Could I tell the difference if dual consciousness existed in my brain?

During a voyage to Australia, a well-known Australian clergyman told me the following story. I give it for what it is worth. A German of his acquaintance was very subject to seeing apparitions, and so real did these apparitions seem, that, unless they were within reach, the observer could not tell whether real persons were present or not, until he discovered that, if he squinted, the real persons appeared double and the apparitions single.

Lastly, let us turn to the case of Felida X., KNOWLEDGE, Vol. VI., p. 522. During her normal condition, Felida X. remembers nothing that happens during her abnormal condition; but, during the abnormal state, she remembers her whole life. Is not this what happens during certain states of intoxication? Policeman X. (not Felida X.) reports that the prisoner was quarrelling with another man when taken into custody. He was extremely violent on his way to the station, and swore terribly, but gave his right name and address. The prisoner told the magistrate he was extremely sorry for what had occurred, but he recollected nothing at all about the circumstances. Some friends had pressed him to take a glass of whisky, and being a teetotaller, it had gone to his head. He also tendered evidence that he was naturally quiet and well-behaved. The magistrate, however, fined him 5s., and did not seem to think dual consciousness necessary to explain his case.

F. W. H., in KNOWLEDGE, Vol. VI., p. 305, says, "It often happens when men are severely injured they are unconscious; soulless for weeks and months; that whole time is a perfect, entire blank to them when consciousness returns, although all other life functions went on as usual. All this appears to point to the same conclusion, that soul and mind are functions of the brain and nerves, which cease with death." With this I quite agree, except that consciousness (soul *) is not a function of the brain. It seems to me that consciousness is no more a function of the brain than the image in a looking-glass is a function of the object reflected. Can "F. W. H." express consciousness in foot pounds? Does consciousness consume any of the beef and mutton I eat? Of course, brain work does. JOS. W. ALEXANDER.

A HUMAN AUTOMATON.

[1576]—Till recently a small carriage-clock stood on a shelf in a bookcase in my lodgings. It was my daily practice to wind the clock up, open the glass door of the bookcase (which closed itself when the clock was taken down), and replace the clock on its shelf. About four weeks ago the clock was permanently removed to the mantelpiece on the other side of the room, and I believe I have not wound it up since, although I have frequently looked at it for the time. To-day (Sunday), however, I took the clock down, set it right, and wound it. Then, instead of replacing the clock on the mantelpiece, I did, unconsciously, what I have done a hundred times before under the same circumstances (*i.e.*, after winding it up); I opened the glass door of the bookcase, placed the clock exactly in its old position on the shelf, closed the door again, and left it. In a very few minutes I was asked the time; again, without thinking, I looked to the mantelpiece, as I have always done, under similar circumstances, for the past four weeks. Then I first discovered where I put the clock. Given stimuli produced given effects on the brain and nerves in both instances. "Was I not in the condition of one of Vaucanson's automata—a mechanism worked by molecular changes on the nervous system?"

My attention was particularly attracted by these facts, after reading Mr. Proctor's last published instalment of "Our Two Brains" (No. 117) and Miss Ballin's first of "Thought and Language." The intelligence of the dog which associated feelings of satisfaction (arising from the consumption of biscuits) with the appearance of a decanter or glasses of sherry, seems to form a link between the mind of the ordinary human being on the one hand, and pure automata, like Dr. Mesnet's soldier or myself in the instances I have noted. W. A. E.

A NEW CLOCK-FACE.

[1577]—From the increasing interest taken in the question of deciding what should be the style of clock-dial for the future, the enclosed novelty may be interesting to you.

Experiments extending over many years have proved to us that numerals, whether Roman or Arabic, are a hindrance rather than an assistance in ascertaining the time with accuracy at an distance, and therefore, in place of these, we substitute plain marks or divisions, the width of each being equal to some factor of the circumference of the divisional circle.

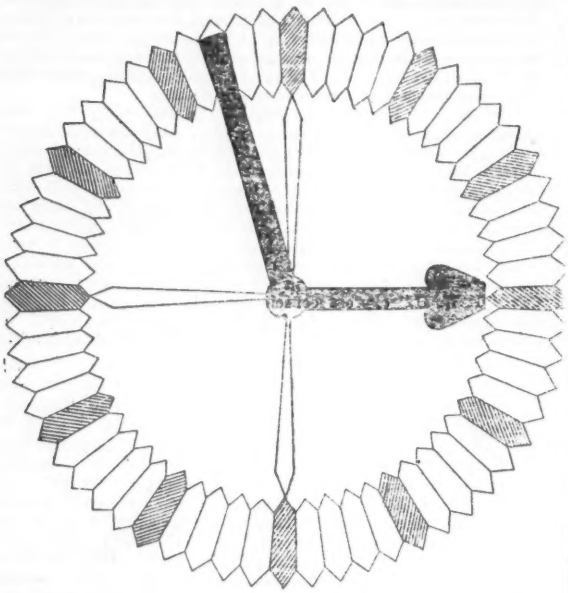
In order to show that the boundaries of the hours do not require

* According to "F. W. H." But volition and consciousness are not exactly identical.

to be numbered, one has merely to look at any of our public clocks at even a moderate distance. Take, for instance, the great clock at Westminster from the south side of the bridge. From this point the observer will be unable to distinguish one numeral from another, yet the time can be ascertained just as approximately and as readily as if each numeral were distinctly seen.

The numerals might be altered to Chinese, Greek, Egyptian, or Assyrian, and the public, unaware of the change, would be able to tell the time just as well as before; distinctly showing that when distance renders the numerals indistinct, the value of each is well known from its relative position, and, therefore, the boundaries of the hours do not require to be numbered. It may surprise many to know that with the two "hands" properly proportioned and adjusted, the time can be ascertained readily, and with sufficient accuracy for all ordinary purposes, from a perfectly blank dial, without a mark of any description!

In the "dial," or rather disc, now submitted to your notice, the numerals and minute subdivisions are superseded by twelve plain



radial marks coloured red (or pink, or "lead," or other suitable colour). These, with the intermediate spaces, which indicate the minutes, and the "hands," which measure as well as point the time, are each equal in width to one-sixtieth of the circumference of the divisional circle. The "hour hand" (the one making one revolution in twelve hours) moves a distance equal to its width in twelve minutes. The "minute hand" moves the same distance in one minute, and, when subdivided near the outer circle, the time can be measured, as the hand advances, to various fractions of a minute. "Afternoon time" can easily be obtained by adding twelve to the hour, thus, ¼ past 3 p.m. = 12 + 3.15 = 15.15.

This "clock-dial" would have the advantage of being easily understood, and that by all nations. Moreover, the time can be ascertained more accurately, more readily, and at a much greater distance than from an ordinary "clock-dial" of equal diameter with Roman numerals, as used in the ancient methods of measuring time by the sun. C. H. and C. W. THOMPSON.

LETTERS RECEIVED AND SHORT ANSWERS.

G. JOHNSON. Yet another request (this time from the London and North-Western Railway Library and Literary Association!) for the gratuitous supply of KNOWLEDGE and of HEALTH, with which last-named paper I have nothing, proximately or remotely, to do. Why the proprietors of a journal should give it away I rather fail to see. If I went to Euston Station and requested a free pass over the line, I suspect that I should be politely but firmly shown to the door of the general manager's office. For the *n*th time I have neither power nor authority to make an eleemosynary distribution of a paper which I merely edit.—J. T. N. kindly answers part of Mr. J. Farrar's query by saying that "Karoo" (Hottentot Karuoa, hard), is a name applied to the open clay flats of Southern Africa, which often rise, terrace-like, to considerable elevations.—J. B. DIMBLEBY. Prior engagements prevented my attendance at your lecture on "Universal Time." I am, however, but little concerned indeed with a system of chronology which so violates familiar facts as to make the world less than 6,000 years old!—JAMES GRAN. Forwarded to the conductor, though I fear that the time at his disposal is very much too limited to admit of it.—H. W. T. It has just struck me that Dr. Mackay's "Manual of Modern Geography," published by Blackwood & Sons, would answer your purpose.—LYONS. Your parrot is suffering from irritation of the skin caused by its diet. Meat, hempseed, and oleaginous food will either or all of them cause it.—F. LANKESTER. I had not a reporter at my disposal on the day specified.—X. In 14 oz. of water that has been boiled and cooled dissolve 154 grains of Shred Castile soap. Put this into a bottle and the bottle into hot water in a saucepan, and shake it up until the soap dissolves. Now set the bottle aside for a few hours for the impurities to subside, and finally pour off the clear liquid and shake it thoroughly up with 9½ oz. of pure glycerine.—EDWIN WOOTON. I must, of course, see it before pledging myself.—SELWYN THORNE. Many thanks indeed. I heartily reciprocate your good wishes.—L. S. Get the volume of Lardner's "Handbooks of Natural Philosophy," on "Hydrostatics and Pneumatics," the new edition published by Crosby, Lockwood, & Co.—W. W. I do not know the address of Mr. Kinnear, the inventor of the self-lighting gas-burner. Perhaps he will advertise it.—CHAS. H. SWINSTEAD, wishes to know, in connection with the chapters on "Modern Domestic Economy," whether a description of the method of getting rid of liquid refuse, such as bath water, that from kitchen sink, &c., will appear? inasmuch as the earth-closet fails to provide for this.—J. H. GARFIT. The reply must come through these columns. To append your address would be to convert your question into an advertisement.—G. W. If we assume B C to equal A B in your figure, it is evident that a gun sighted to strike B (when fired from A) would not strike C when fired from B, with the sight intact. Take, for simplicity, what is called point-blank range. Now, be the trajectory ever so flat, the ball will begin to fall the instant it leaves the muzzle. Hence the gun must be elevated more or less above the horizon, even when fired at a horizontal object. If, though, we were firing vertically, the axis of the bore produced must pass through the object aimed at. The range varies with the angle, the maximum range, in vacuo, being obtained with an angle of 45° of elevation. For, calling R the range, V the initial velocity, a the angle of projection, and g the force of gravity, $\frac{R = V^2 \sin 2a}{g}$; whence, obviously, R is greatest when $2a = 90°$ or $a = 45°$. The way in which this affects the flight of shot over a given linear interval is pretty obvious. It is, though, utterly impossible to teach even the rudiments of gunnery in an answer like this.—W. A. SHEPPARD. Do you seriously suppose that I am going to insult the readers of KNOWLEDGE by the insertion of your hopeless twaddle about "The Immobility of the Earth?"—COMMENTATOR. Assuredly I have not the slightest wish to quarrel with you, but you sent me a goodly part of a quire of paper containing observations *de omnibus rebus et quibusdam aliis*, and I said, periphrastically perhaps, but pretty plainly, what my opinion of their worth was. I am not concerned to deny that you are "a man of genius," nor even that "a kind of inspiration" may have dictated your comments; all I feared was that our readers would fail to recognise this. Perhaps some evolutionist will reply to your question as to whether sexual distinction was originally acquired by natural selection? and to your second one, as to why the carnivora were created, if vegetables were the natural food of animals; and whether man himself may not have acquired his taste for flesh-food and his concomitant supremacy by natural selection too? Many thanks for the most picturesque photographs.—JOHN KIRK. I regret that these columns cannot be made the channel for appeals for charities (however deserving they may be) save as advertisements.—R. T. SHEA. There is an excellent work on bookbinding by J. W. Zaehnsdorf, published by Bell & Sons, London, and a smaller and cheaper one by Crane is just advertised by L. Upcott Gill.

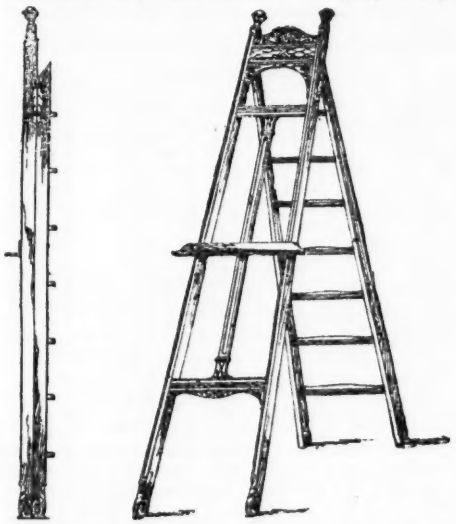
THE BENNET-MACKAY CABLES.—The success of the new Commercial Cable Company, from a business point of view, has been very satisfactory, the number of messages being, it is said, 1,000 on the fourth day after the opening of the system for public traffic. Dr. Muirhead has applied an improved system of duplex to the cables, which, we understand, transmits practically double the number of messages, which the simplex or ordinary system sends. Press messages are charged for at the rate of 6d. per word; and commercial messages are subject to a sliding-scale of prices, which has its upper limit at 1s. 8d. per word, and its other rates depending on the number of messages annually sent by the party.—*Engineering*.

Our Inventors' Column.

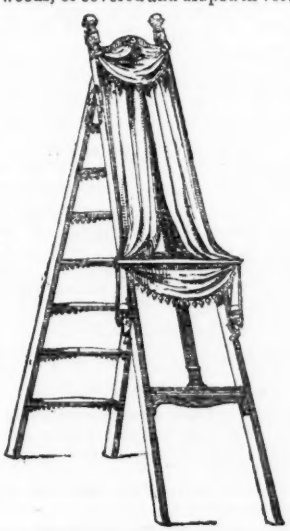
We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

COMBINED LIBRARY STEPS AND EASEL.

[Patent No. 4889. 1884.]—The accompanying illustrations depict a very simple combination (patented by Mr. G. H. Hampton), completely doing away with the usual unsightly library steps,



forming instead an artistic and useful adjunct to the library or drawing-room. The steps are perfectly rigid, yet easily folded, and are made in all woods, or covered and draped in velvet or plush. The



construction is so simple as to obviate any necessity for further details than are afforded by the illustrations. The top left-hand figure shows at a glance how compactly the steps may be folded when out of use. Their height is then six feet.

SHIPS IN FOGGY WEATHER.

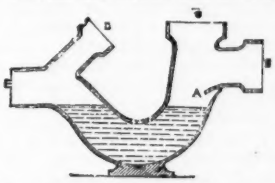
[Patent No. 8,794. 1884.]—Mr. F. D. Torre, of Baltimore, U.S.A., has patented a device to provide ships with means for detecting in foggy weather or at night the proximity of land, icebergs, vessels, or other solid objects. The principle made use of is that of the echo, and the means employed consist principally of a sound producer and a sound receiver. In the arrangement is a bell, the sound emitted by which is reflected from any solid body in the proximity of the ship, and returns to a receiver which is pivotted to a stem fixed on the fore part of the deck. A telephone is attached directly to the receiver, or a microphone may be inserted therein and connected by a wire with a telephone which the signalling officer keeps to his ear. The arm of the receiver is provided with a compass and a timepiece, by means of which the direction and distance of the reflecting body can be readily found, the time between the transmission and receiving of the sound being noted. If desired, the telephone and timepiece may be removed to the cabin, and the bell worked therefrom, by which arrangement the interference of extraneous noises will be obviated.

THE ECLIPSE INKSTAND.

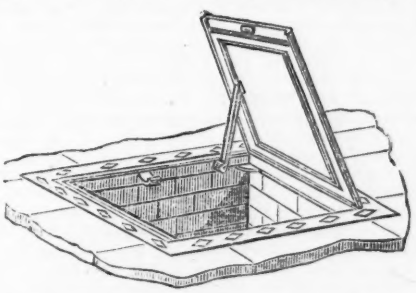
THIS very simple and ingenious inkstand is handsomely constructed of bronze, is circular, and presents a really ornamental appearance. It contains three cups, one for red, one for blue, and one for copying ink. The lid, which is perforated with a single hole the size of the top of the cups, fits on to the disc containing them by a tapered square pin dropping into a depression of the same shape. By this arrangement only the kind of ink in actual use is exposed, and when another sort is required the lid is simply turned round. When the writer has finished, a blank part of the bronze disc containing the cups is brought under the hole in the lid, and all three inks are securely covered from air and dust. It is patented by Messrs. E. Wölff & Sons, Great Queen-street, London, W.C.

DRAIN PROTECTORS.

MR. A. T. ANGELL, of Fulham, has patented a lip-syphon, the great feature of which is the projecting lip A, which throws the water passing down the drain off the sides, and directly into the centre of the body of water forming the trap, thus securing a thorough flush. It is obvious, too, that no gases can pass from the sewer into the house. The same inventor



has patented an air-tight flap, for fixing over the "inspection boxes," which, in the best forms of drainage, are built over the "junctions," *i.e.*, where the tributary drains intersect with the



main artery, and they thus form a good landmark, showing the exact position of the drains, so that the pulling up of flagstones and flooring, and the pernicious practice of breaking open the drains need never be resorted to in case of a stoppage.

THE production of maize in the United States during 1884 is said to have been greater than in any previous year. It is estimated to have amounted to 1,975,000,000 bushels.

THE sanitary inspector of the New York Board of Health reports that, out of some sixty firms engaged in sugar manufactories, thirteen were using chromate of lead, and five of these were also employing red lead, fuchsine (a preparation of mercury), Prussian blue, and other distinctly poisonous pigments containing lead, mercury, and arsenic.

Our Chess Column.

By Mephisto.

CITY CLUB *VERSUS* ST. GEORGE'S.*

THE second match between these two powerful clubs—an event looked forward to with the greatest interest by the Chess world—was played on Monday last, the 19th inst., at the Salutation Hotel, 17, Newgate-street. It will be remembered that at their first meeting, on March 24, 1881, the West End Club, with teams of sixteen aside, was victorious by 12 games to 10. The official score, however, ignoring one game, Potter *versus* Owen, gave 12 to 9 as the final result. The City men slept on their defeat pretty soundly for nearly four years. Their awakening, however tardily, has proved a "revelation" to their opponents, as we now proceed to relate. The players were divided into two sections, placed in different parts of the hotel, an arrangement which secured comfort both for them and for the spectators. We give below the names of the members of each team, the openings adopted (the first player of each pair being marked with a *), and the full score. In the present match the teams were twenty aside, and the games restricted to one between each pair of combatants.

Play began at 6 p.m. Interest first centred around Mr. Stevens' game, who at the 17th move won a piece, and, pursuing his advantage, very prettily gained the opposing Queen for Rook and Bishop, forcing Mr. Ball to resign on the 31st move. First blood for the City. Matters were equalised in a few minutes by Mr. Laws surrendering to Mr. Gover, after an end game with seven Pawns on each side, but the City regained the superiority shortly by the victory of Mr. Hirsch over Mr. Warner. A look round the lower room showed the advantage on most of the boards to lie with the home players, and the friends of the City were hopeful. Mr. Leonard drew his game soon after, and almost at the same time the veteran Wyvill struck his flag to Mr. Anger. Score: City 3, St. George's 1, drawn 1. The City men now went right away. Mr. Heppell, who had gained an extra pawn on the King's side, utilised his superiority skilfully, and won of Mr. Lewis. Soon after Mr. Wilson, who had won a piece against a doubled passed Pawn, compelled Colonel Duncan's surrender. Dr. Ballard shortly found further resistance hopeless against Mr. Gunsberg, who cleverly made the most of a premature attack instituted by his opponent before he had castled. The City men were now radiant. Score 6 to 1, and 1 draw. The fainting hopes of the West-end men were somewhat revived by Mr. Puller, who had obtained a dangerous supported passed Pawn at Queen's 6th, scoring against Mr. Cohen. At this time, the game of Messrs. Potter and Wayte attracted the lion's share of attention, for Mr. Potter, who had opened with a double Fianchetto, was breaking in upon his opponent's King. Mr. Gattie next drew, against Mr. Frankenstein, a difficult ending with a Pawn behind, and Mr. Marett, who had retained Knight against Bishop for the end game defeated Mr. Watts. It was now a quarter to ten, and the score stood—City 6, St. George's 3, drawn 2. After this temporary check the City men again went ahead, scoring the next three games. Mr. Lord, who had gained a piece for three Pawns, won of Mr. Ranken, Mr. Heathcote surrendered to Mr. Taylor; and Mr. Chappell, who played with great steadiness, defeated Colonel Minchin very neatly. A drawn game ensued between Messrs. Vyse and J. I. Minchin. Mr. Minchin had succeeded in getting a passed Pawn to its sixth square, but could not utilise it to a win. Fifteen games out of the twenty to be played were now accounted for, and it was obvious that the City would reverse the result of the previous match by a handsome majority. The score at this point (10.20) stood: City, 9; St. George's, 3; drawn, 3. Mr. Block, after a tough fight, gave in to Mr. Skipworth, and an equally hard struggle between Mr. Bussy and the Rev. Mr. Lewis ended in a draw, with a Pawn advantage to the former, but Bishops of opposite colours. Next followed the drawing of the game between Messrs. Potter and Wayte, the forcible entry of the former having proved insufficient to win. The impassable coolness of these veteran players at the crisis of the game, surrounded by a densely-packed throng, was the subject of general admiration. Two games remained unfinished at "time" (11 p.m.). The first, between Messrs. Hooke and Plunkett, contested with surprising evenness throughout, was adjudicated a draw, and the other was given in favour of Mr. Salter, against the Rev. Mr. Earnshaw, by Dr. Zukertort, the umpire. Thus the City Club won by 9 games to 5, and 6 draws, or, counting in the draws, by 12 to 8, a signal revenge for their former defeat. The company included almost every one of note in London Chess circles, and not a few provincial celebrities.

Mr. Adamson is to be congratulated upon his excellent arrangements for the comfort of all.

* Crowded out last week.

City.		St. George's.		Opening.
Potter*	½	Wayte	½	Double Fianchetto
Gunsberg	1	Ballard*	0	French defence
Block*	0	Skipworth	1	English game
Lord*	1	Ranken	0	Ruy Lopez
Heppell	1	Lewis, F.*	0	Sicilian
Vyse*	½	Minchin, J.	½	Q Gambit dec.
Hooke*	½	Plunkett	½	Zukertort's op.
Frankenstein	½	Gattie*	½	Centre counter g.
Earnshaw	0	Salter*	1	Van't Kruys
Cohen	0	Puller*	1	Zukertort's op.
Anger	1	Wyvill*	0	Van't Kruys
Hirsch	1	Warner*	0	English game
Stevens*	1	Ball	0	Ruy Lopez
Laws*	0	Gover	1	4 Knights game
Wilson*	1	Duncan	0	Giuoco Piano
Chappell	1	Minchin, Col.*	0	K. B. P. game
Bussy*	½	Lewis, Rev.	½	French defence
Leonard	½	Burroughs*	½	French defence
Watts	0	Marett*	1	French defence
Taylor*	1	Heathcote	0	Ruy Lopez
	12		8	

The following game was played in the above match:—

French Defence.

White. Dr. Ballard.	Black. J. Gunsberg.	White. Dr. Ballard.	Black. J. Gunsberg.
1. P to K4	P to K3	22. R to K4	B to B4
2. QKt to B3	P to Q4	23. R to QB4	P to B3
3. P × P	P × P	24. Kt to B2	P to R4
4. P to Q4	Kt to KB3	25. P to KKt4	B to K3
5. B to KKt5	B to K2	26. R to B5	B to R5
6. B to Q3	Castles	27. Kt to B4	R to KB sq.
7. B × Kt	B × B	28. Kt to Q3	P × P
8. Q to R5	P to KKt3	29. K to K2	B to Q4
9. Q × P	B × P	30. R to R5	P to QKt4
10. Q × Q	R × Q	31. R to R7	P to B4
11. KKt to K2	B to QKt3	32. R to Q7	B to B6 (ch)
12. P to KR4	Kt to B3	33. K to Q2	P to B5
13. P to R5	Kt to Kt5	34. Kt to K5	B × Kt
14. B to K4	P to KB4	35. Kt × B	R × Kt
15. P to R3	P × B	36. K to K2	R to B5
16. P × Kt	P to K6	37. R to Q5	B to Q5
17. P × P	B × P	38. R × P	R to B7 (ch)
18. P × P	P × P	39. K to Q sq. (2h.)	P to B6(42m)
19. R to Q sq.	B to K3	40. P to Kt3	R to Q7 (ch)
20. R to R4 (1h.)	R × R(ch)23m	41. K to B sq.	B to K6
21. Kt × R	B to KKt4	And Black won.	

SOLUTIONS.

Problem No. 145, p. 40.

1. Kt to Kt4

If 1. K × Kt	2. R × P mate	If 1. K × R	2. Q to Kt sq. m.
If 1. B × Kt	2. R × Kt mate	If 1. B × R	2. Kt to Kt7 m.
If 1. B × Q	2. R × Kt mate	If 1. B × B	2. R to Q5 mate
If 1. P × P	2. Kt to Kt 3 m.	If 1. Kt × R	2. Q to K7 mate

Problem No. 146, p. 60.

1. Q to R 3 — P × B
2. Kt to K7 — K × Kt or 2. K to B5
3. Q to B3 mate — 3. Q to Q6 mate

If 2. B × Kt — 3. Q × P mate, or if 2. K to Q5 — 3. Kt to QB6 mate
1. Q to R3 — K × Kt (B3) — 1. K × Kt (B4)
2. Q to K7 (ch) — K moves — 2. Q × P — any
3. Q to Kt5 mate — 3. Q mate accordingly on Kt5 or K4

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

John Bennett.—4. P to Q4 in the Evans Gambit is not a particularly good reply. We shall deal with it later on.

Correct solutions have been received from W., G. A. A. Walker, W. Furnival, M. T. Hooton.

George Woodcock.—Games received; will look over them as soon as possible. Solution correct.

F. J. D.—Game received; will publish it soon.

Correct solutions received from W., H. W. Sherrard, A. W Overton.